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FACTORY INSPECTION AND FACTORY INSPECTORS *

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I. FACTORY INSPECTION IN THE UNITED STATES AND ABROAD

THE purpose of labor legislation is the protection of the working population. This protection was necessary, especially at the beginning of the present economic era, because of the economic pressure and the inability of the working class to protect itself. The protection given began with regulation and restriction of child and female labor, and gradually extended until it embraced economic, sanitary and health phases and conditions of labor. The extent of protection given to the workers by the labor laws promulgated did not, however, and does not depend upon the *number* of these laws or the extent of labor legislation. The real protection given to workers depends solely upon those laws which are actually enforced, and the real value of labor legislation depends only upon the extent of its realization and proper enforcement.

There is no greater danger to the social fabric than empty parliamentary promises, or labor laws dead upon the statute books. The non-enforcement of labor laws breeds discontent and fosters anarchy. It makes law seem a mockery, protective legislation, a snare and delusion. It creates resentment. It forces the labor population to lose all hopes for protection from the state and community. It compels it to seek more forcible means of self-protection.

The enforcement of labor laws presupposes the setting up of a machinery for the purpose. Such machinery consists in the organization of so-called labor departments and factory inspection bureaus. Factory inspection has always lagged behind labor legislation. The advocates of protective legislation and the proponents of labor laws, as a rule, at first ignored the necessity of creating special bureaus for factory inspection. Only after time had shown that the mere enactment of labor laws was insufficient to give proper protection to the workers, was it possible to persuade legislatures to make special provision for enforcement of these laws.

The beginning of factory legislation in England dates back to the year, 1802, when the first known labor law was promulgated, but it was not until 1833 that the first attempt was made to establish a factory inspection department. In France there were labor laws issued during the first three-quarters of the nineteenth century, but no labor inspection department was established before 1874. The same applies to Prussia, Austria and other European countries.

Factory inspection in the United States likewise lagged behind factory legislation and years elapsed before it dawned upon legislators that not only factory laws but provisions for their administration were needed. Although a number of labor laws aiming at child and woman labor protection were issued by the legislatures of various states all through the middle of the nineteenth century, it was only in 1886 that Massachusetts attempted to es-

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tablish factory inspection, and in the same year a factory inspection bureau was established in the state of New York, followed by Pennsylvania in 1889 and Illinois in 1891. In Wisconsin, factory inspectors were appointed in 1887 and in New Jersey, theoretically in 1883 but actually in 1889.

Sponsored by social workers and philanthropists, advocated by far-seeking statesmen, and, at first, but feebly supported by the labor elements themselves, labor protective laws invariably met a bitter and strenuous opposition on the part of organized and unorganized employers. Strong, however, as the opposition was against the enactment of protective labor laws, still stronger was the opposition to the creation of machinery for the enforcing of labor laws. To this united and strong opposition of employers against factory inspection was due the lagging of legislation for factory inspection in many of the countries abroad and in the states in this country. The same forces assisted in rendering the newly created machinery for labor enforcement but feeble bulwarks against the power of factory owners and employers.

The value of factory inspection and the extent of protection given by factory inspection departments naturally depend upon the organization of the machinery for enforcement, upon the scope and functions given to the department, its powers, rights and duties, the proper appointment of its higher personnel and the selection and appointment of the rank and file of the inspectors.

From the beginning of the creation of factory inspection departments, they suffered much and still suffer from lack of proper organization, inadequate conception of the scope and functions, insufficient powers and inadequate rights, bad selection of the higher personnel and an indequate and insufficient selection and training of the rank and file of inspectors. In a report on "The Efficiency of Factory Inspection Machinery in the United States" (1), the inefficiency of the factory inspection machinery in the United States is stated in a nutshell as follows: "The most dangerously unguarded machinery I have known is the machinery of factory inspection in the United States, exposed to a most pernicious political influence and to the parsimony of legislators, rendering possible the industrial diseases and accidents which a provident nation would promptly make impossible. In twenty states the head of the labor department is designated by the governor and his term of office depends usually on the political fortunes of his chief. The absence of a permanent character in this important post makes it possible for politics to play no uncertain game, both in the choice and in the character of the man who is sworn to enforce the labor laws. To my mind no state, except possibly Massachusetts and Wisconsin, has entirely freed its labor department from a destructive political influence. In Pennsylvania I found that many of the factory inspectors were conducting private business enterprises while holding commissions in the department. One is alleged to have sold fire insurance. Another kept a saloon. Still another was in the coal business. In another state, where the chief factory inspector divides his time between conducting a livery stable he owns and the business of caring for some 30,000 factory wage-earners, I found him contributing a remarkably concise annual report consisting of exactly fourteen words. It reads, under date of July 1, 1911, as follows: 'I have visited the same factories as last year and find conditions the same.' "

The report of the investigations made by the National Civic Federation in 1910, the reports made by the American Association for Labor Legislation and the reports of the factory inspection departments themselves, all tend to prove the same—the insufficient power and rights accorded these departments, the inefficiency of the organization, the narrowness of their scope and functions, the improper selection of the heads and chiefs of departments and bureaus, and the low status of the rank and file of the inspectors.

It is needless to state that these fundamental defects in factory inspection are bound to affect deleteriously the enforcement of labor and factory laws in the country, to nullify the extent of protection intended to be rendered by these laws, and to create disregard and contempt of factory inspection alike among workers and employers. The workers, organized and unorganized, feel the inadequacy of protection given to them by the many de-

partments and bureaus created for that purpose. They know that many of the labor and factory commissioners have inadequate power, even if they have the will to enforce labor laws. They know that the average labor commissioner and chief factory inspector is a legal appointee, subservient to the political powers that be and but seeking to keep his position during the temporary political hold of his party. They know that an annual, single, cursory inspection of the factory where they work is of very little avail if not conscientiously followed up. They also know the incompetency of the average factory inspector, his lack of knowledge and experience and the absence of zeal and enthusiasm for his work.

The employer, on his part, regards factory inspection with suspicion and treats factory inspectors with contempt. In an experience of twenty-five years I have found few employers who give due respect to factory inspectors. During my directorship of the investigations of the New York State Factory Commission in 1911 and 1912, I have been told over and over again by a large number of factory owners that they cannot trust the average factory inspector, and, as a rule, they disregard his criticisms and recommendations. "Who is the average factory inspector anyway and what does he know?" were the usual queries. "As a rule, he has no knowledge whatever. He is an absolute ignoramus. He cannot distinguish a belt shifter from a steam pipe. He knows nothing about machinery. He has no conception of the needs of the particular establishment which he is supposed to inspect. His criticisms are often foolish and his recommendations ridiculous."

Indeed, the average factory inspector is rather an inefficient official. He has seldom graduated from high school. He owes his appointment to political preferment or to an inadequate and inefficient civil service selection. He has had no training for his work. He lacks technical knowledge and does not possess mechanical abilities. He regards his position as temporary. He changes it as soon as he finds something better. He has no faith in his own work; no understanding of its scope and functions. He has no hopes for promotion, no outlook for the future. He receives few commendations for work well done. He is often criticized for treading upon the toes of politically powerful employers.

In the summer of 1913, I had the privilege, as representative of the U. S. Department of Labor, of making a study of factory inspection in six European countries (2). It may perhaps be pertinent in this place to state that the results of my studies clearly proved that factory inspection abroad is much more efficient and adequate than in this country and that the rank and file of European factory inspectors are far above the rank and file of our own inspectors; that the superiority of European inspection over that of the United States lies almost solely in "the higher grade and character of the inspectorial force"; that Europe is, in this respect, far in advance of the United States; and that we have no such factory inspectors as a class. Here and there in one state or another there may be found one or more examples of efficient and trained factory inspectors, but these are isolated cases.

The reasons for the superiority of factory inspectors abroad have been summarized in that report as follows: (1) Factory inspection in Europe is a profession and a vocation and is regarded as a life work; (2) factory inspectors in Europe must come through a long preliminary preparation, must have a scientific education and technical training; (3) merit, length of service and competence are the only basis for promotion from one grade to another; (4) superiors, chiefs and heads of the service are promoted from the ranks only for merit, experience, length of service and competence; (5) tenure of office is secure; promotion certain; treatment liberal, and a pension given for long service and old age.

Much remains to be done if the purpose of labor legislation is to be fulfilled, if real and adequate protection is to be accorded to the labor population. The foremost task, however, is to insure the recognition of the need of reorganizing factory inspection in this country and the recognition of the new tendencies and principles of labor legislation and the new necessary methods of factory inspection. It is imperative to raise the status of the factory inspector and to put factory inspection on a higher plane. There is likewise absolute need of a radical change in

the methods of selection of factory inspectors and in the creation of facilities for the proper training of factory inspectors in this country.

I shall discuss the subject in the following sub-divisions: (1) New Principles and Tendencies of Labor Legislation and New Methods of Factory Inspection; (2) The Status of the Factory Inspector; and (3) The Qualification, Selection and Training of Factory Inspectors.

II. NEW PRINCIPLES AND TENDENCIES IN LABOR LEGISLATION AND FACTORY INSPECTION

Over a hundred years old in England, much less in other European countries, and hardly two or three score years old in the United States, labor legislation has made giant strides and has achieved phemonenal progress during these years. From the simple enactment of the "Apprentice Law" of 1802, scarcely a few pages long, labor laws have been augmented, increased and multiplied until now, in most of the countries, they fill large volumes and constitute a formidable code. From the simple regulation and restriction of certain phases of child labor, labor legislation has progressed until it practically embraces every phase of working conditions; regulating, restricting, prohibiting and otherwise guiding all labor and its processes; protecting the workers; regulating hours of labor; prescribing the form, manner and minimum of wage payments; improving the sanitary and other conditions in industrial establishments; providing standards for mechanical equipment; supervising processes of work; and promoting the health and preserving the lives of the workers in workshop, factory, mine and quarry.

This progress, great and remarkable as it is, has been achieved by a slow and, at times, painful process. It has been achieved in spite of opposition and in the face of the indifference and negligence on the part of the workers themselves. Only gradually, as the workers through their organization became convinced and conscious of their power, and when the employers themselves came to the conclusion that it does not pay to neglect the human factor in industry and that industrial productivity and efficiency are increased with the improvement of labor conditions —only then did it become possible to induce legislators to pass those salutary laws which are at present on the statutes of every labor code in every civilized country.

It is unfortunate that in this progress of labor legislation, labor law enforcement and factory inspection have not kept pace. While labor legislation has continued to include new phases of working conditions, while the simple regulations, restrictions and prohibitions of child and female labor have gradually given place to exhaustive and far-reaching measures to prevent industrial accidents and occupational diseases, the machinery for enforcement of these laws has remained based upon the same old principles and has followed the same old methods which were suitable only to the primary phases of labor legislation.

Thus, when the labor law meant nothing but regulating the maximum hours of labor for children of certain ages and for women, the enforcement of these laws was a simple police measure, based upon the police power of the state, and the methods employed by the factory inspection departments were what may be called "detective." All the inspectors needed to do to enforce these simple provisions of the law was to visit industrial establishments at unexpected times and to find at work children under age, or to swoop down upon the factory after hours to discover the work of minors during these prohibited times. These *detective* methods of inspection naturally required little knowledge and experience on the part of the inspector, an official of rather low status, a person with the qualities of a police dedetective rather than one with a high education, knowledge and general industrial experience.

A prominent labor leader, a former chief of a factory inspection department in a great state, once, in a lecture on factory inspection, stated that "the value of a factory inspection department and the measure of success achieved by factory inspectors may be determined by the number of prosecutions instituted and won for infringement of the labor law." This is tantamount to saying that the efficiency of a police officer is determined by the number of arrests he makes and by the number of thieves found in his district, and the

value of a teacher is determined by the number of grammatical and other mistakes made by his pupils. Such thorough misconception of the important functions of factory inspection is explained only by the fact that this labor authority considered labor laws from the view of enforcement of child labor laws only, and hence regarded as the most valuable factory inspector the one who succeeded in spying out the largest number of violations of the child labor law and in successfully bringing the culprits to justice.

Factory inspection, its principles and methods, must necessarily change with the new tendencies of labor legislation. The basis of labor laws at present is not the simple restriction of child and woman labor, important as this is, but the prevention of industrial accidents and occupational diseases; measures of fire protection, of safety, of proper factory construction; arrangements for light, ventilation and sanitation; the regulation of industry to prevent occupational diseases and to preserve the life and promote the health of the workers—all of which demand a change in the principles, methods and procedure of labor law enforcement and factory inspection. Detective methods of inspection must give place to preventive work on the part of the inspectors.

These changes must necessarily react upon the status and character of the factory inspectors themselves. Detective inspection may be performed by ignorant and inexperienced men. Not so with preventive inspection. To note defects in construction, to detect inadequate fire protection, to realize the inadequacy of unguarded machinery, to test the amount of light and character of ventilation, and to propose proper means for prevention of accidents and occupational diseases, a new and different character of inspection, as well as a new type of inspector, is required. Wide experience in industrial fields, great technical knowledge, mechanical ability, considerable hygienic erudition—all are required for the new enforcement of labor laws and for the new preventive factory inspection.

Has the organization of factory inspection departments followed the progress of new labor legislation? Have the methods of factory inspection been adjusted to the new needs and requirements? Have the factory inspectors become proficient in the new knowledge demanded from them? Are the new factory inspectors appointed of a higher class, conforming to the new principles, methods and needs of labor legislation and enforcement? Unfortunately, the answer must be in the negative as far as conditions in this country are concerned.

There is yet another and very important problem of labor legislation and administration which likewise cries for a solution. This is the growing need of specific industrial legislation. When labor laws consisted in the regulations of the age of workers, the hours and other simple conditions within the industrial establishment, the labor laws were and could be general, applied alike to all parts of the country, to all industries and establishments. This is no longer so. With the progress of labor legislation and need of more detailed industrial regulations, specific rules for certain districts, special regulations for certain industries, and detailed proscription of individual industrial processes become a necessary part of labor legislation. Moreover, special industries and individual industrial establishments may at certain times need special regulations, exemptions and exceptions. All this cannot emanate from general national or state legislatures. These law-giving bodies have neither the knowledge nor the experience to legislate for each and every industry, industrial establishment, period or occasion. It, therefore, becomes incumbent either to give to the law enforcement machinery or to the factory inspection department legislative power to make rules and regulations, to grant exemptions and exceptions, or to create a separate body attached to each factory inspection department for these purposes and functions.

This problem has been solved variously in different countries and in different states. England has empowered the Home Secretary to issue special rules and regulations and give exemptions and exceptions, not, however, without certain restrictions requiring public hearings and the co-operation of employers and workers. The Home Secretary, therefore, becomes an ancillary legislative power with wide administrative duties and rights.

Germany and Austria attempted to solve this problem by an entirely different method: (1) by making the labor law very general, leaving its interpretation and application to the factory inspectors, and (2) by requiring a large number of industries and industrial processes to be specially licensed. The gist of Article 120 of the Industrial Code of the North German Union as well as of Article 74 of the Industrial Code of Austria contained the following general provision:— "Employers are to establish and to maintain their establishments, workrooms, machines and utensils so as to protect workers as far as the nature of the industry permits against the dangers of injuries to life and health. They are also to provide such devices as are necessary for the protection of the workers against dangerous machinery or against any other dangers to health and life." These paragraphs, giving but the fundamental principles of labor protection, are the basis of the various rules and requirements which are made by factory inspectors in each district of the country and which are intended to adjust the methods of protection to each industry, industrial establishment and period of work.

On the other hand, the licensing of a very large number of industries, especially those where there are certain dangers to limb, health and life, and the rigid rules and regulations required for the new construction of these establishments, for new equipment and installations, gradually render the more important and more dangerous industries and establishments more and more safe for their processes and their workers.

In the United States, the need of special rules and regulations to be applied to certain parts of the country and to certain industries has led to important changes in the constitutions of labor departments and factory inspection bureaus. The first change was in the adoption of the so-called, "Wisconsin idea," the creation of the Wisconsin Industrial Commission with the general mandate to "take charge of the safety of the workers," leaving the definition of "safety" to the commission and permitting it to "make such rules and regulations and adopt such provisions and standards as, after proper investigation, it may deem fit." After the work of the New York State Factory Commission in 1911-1913, New York State established an Industrial Board, composed of several persons, with the sole legislative function of providing special rules and regulations and giving of exemptions and exceptions to special trades and establishments. This, however, was shown to be unsatisfactory, and later New York State, soon followed by Massachusetts, Pennsylvania, New Jersey, Illinois and other states, reorganized its machinery for enforcement of labor laws and changed its single-headed labor department and factory inspection bureau into an industrial commission with several members, giving this commission not only executive but also legislative and judicial rights and powers.

As has been stated above, the new and comprehensive labor legislation and the need of preventive inspection required a higher status of the enforcing personnel and a change in the character of the factory inspectors. This problem has also been solved differently in different countries and states.

Factory inspection in England began with a high conception of the importance of the functions of the factory inspectors. The first four factory inspectors appointed in England in 1833 were men of high calibre, scientific attainments, social standing, industrial knowledge and experience, and, incidentally, highly compensated.* It is fortunate that England selected inspectors of such high calibre, otherwise factory inspection might have proved a failure in that country and its progress much retarded in other countries as well. It is due to the high character of its first factory inspectors that England succeeded in compelling employers to respect them, in proving to workers the impartiality of factory inspection, and in compelling legislators to listen to the advice of these recognized and respected experts. The character and status of factory inspectors in England has never been lowered. There factory inspection has become a highly specialized profession, where specialists—medical, engineering, etc.—have been called to take charge of certain special phases of factory inspection. At the same

*The salaries of the first factory inspectors in 1833-34 were 1000 pounds, about $5,000, equivalent now to $10,000 or $12,000.

time England has not neglected the enforcement of the restrictive and prohibitive child, woman and workshop regulations, having created a separate force of *assistant inspectors* to take charge of this work, requiring detective inspection and lesser qualifications.

Germany and Austria have again followed their own peculiar methods of solving the same problem. In these countries there is hardly any specialization but, on the one hand, detective inspection and the enforcement of child and female labor laws and minor restrictions have been entirely taken away from the factory inspection departments and concentrated in the local police authorities, who have sole charge of the enforcement of restrictive and prohibitive labor regulations and of all factory violation prosecutions. On the other hand, by a special method of selection and by a highly developed method of training, the factory inspectors of Germany and Austria are so highly educated in industrial hygiene and have become so expert in industrial matters, that they are well able to take care of all the phases of enforcement of preventive factory inspection and are fully competent to serve as the final arbiters in matters of licensing especially dangerous industries and establishments.

In the United States the process of adjusting the enforcing personnel to preventive inspection is progressing very slowly and has as yet attained comparatively little success. The appointment in 1907 of a medical factory inspector in New York State and in 1912 of two medical factory inspectors in Illinois and the establishment of industrial hygiene bureaus and divisions in New York, Wisconsin, Illinois, Massachusetts, Pennsylvania, New Jersey and other states is a result of the need of a specialized and higher class of inspectors to perform preventive functions of factory inspection. It is to be regretted, however, that in the establishment of these industrial hygiene bureaus and divisions and in the selection and appointment of their personnel, the same faulty methods have been used which, as I shall later endeavor to prove, are the main factor in the inadequacy of factory inspection, in the low status of the factory inspectors and in the inefficiency of factory inspection work in this country.

III. STATUS OF FACTORY INSPECTORS

The enforcement of labor laws depends upon the proper machinery for enforcement, and upon the adequacy, competency, efficiency and experience of the persons selected for factory inspectors. The character of factory inspectors, however, depends upon their status.

In Germany, Austria and other countries factory inspection is a profession. The factory inspector is an important official. He possesses rank similar to the state physician, the state architect, the state engineer and other state officials. He is a part of the state bureaucracy. He starts with the rank of an industrial assessor and passes through the stage of industrial inspector to that of industrial counselor, and has a chance of promotion to the highest rank attainable in the official bureaucracy. Possessing rank and knowledge, the factory inspector is highly respected by the employer with whom he comes in contact as well as by the workers. Being a highly trained official with wide experience in various industrial matters, his criticisms of industrial defects and his recommendations as to their improvement are listened to with respect and submitted to with grace by the trained superintendents, managers and foremen of industrial establishments, for these acknowledge the superior knowledge and experience of the inspector in his specific field. The tenure of office of the inspector is perfectly secure; his promotion gradual and assured. At the expiration of a stated term and in disability and old age, the inspector is assured a pension.

In Belgium the factory inspector of low rank who was assigned to accompany me through the factories was a trained technical engineer, who deliberately chose factory inspection as his career. On my inquiry he told me that this was just as liberal a profession in his country as medicine, law, etc., and that within a certain period he expected to become chief inspector. He regarded his profession as a life's work, to which he brought all his acquired knowledge and experience.

In England, while not possessing rank, the factory inspector is usually a college-bred man, a technically trained official, a man sure to inspire the respect of the factory owners and the confidence of the workers.

In this country factory inspection is not a profession. The rank of factory inspectors is recruited from a heterogeneous, nondescript class, the majority of whom have failed in some other pursuit of life. This is the case not because it is absolutely impossible to get highly qualified persons to make careers of factory inspection, but because of the low status of the factory inspector's position.

The tenure of office of the inspector is insecure. Even where he is protected by civil service regulations, the protection is more apparent than real. In those states where no civil service protection whatever is given, the tenure of office depends on the political or personal will of the chief inspector, usually himself a political appointee. Doubting the security of his tenure of office, the factory inspector has no desire to take up the subject seriously, to devote his time to the gaining of knowledge and experience in his field of work, or to regard it as his career.

To the insecure tenure of office must be added the low pay of a factory inspector. In an investigation of this subject a few years ago, the American Association for Labor Legislation made a compilation of the pay of factory inspectors in various states. It found salaries ranging from $900 to $1200 per year. In some states it was lower. This means that the factory inspector must expect to be satisfied with a weekly wage of between $18 and $23, a sum much less than the wage nowadays of an assistant plumber or carpenter. While the salaries of American factory inspectors are much higher than the salaries usually paid to factory inspectors in France, Germany, Austria and other continental countries, they are much smaller than the salary paid to the English factory inspector. The maximum salary which a factory inspector may hope to attain is $1800 and but few may attain this sum.

English as well as continental factory inspectors are assured pensions after a certain term of years in office and after disability and in old age. These pensions amount to from half to two-thirds of the salaries which they received during service. In this country there is no state that gives pensions to its factory inspectors. I have known men who have grown gray in service and who, in their old age, were discarded into the scrap-heap because they were no longer able to pursue their work. With low pay, insecure tenure of office and no assured income in old age, can one blame a man for refusing to choose factory inspection as a profession, or to stay in the work if it is possible for him to better himself?

Another cause of the low status of factory inspectors in this country is their shabby treatment in matters of promotion and selection of chiefs. The continental factory inspector knows every step of his promotion. He knows all the stages through which he must pass if he but follows the routine of his work. No superior in the factory inspection department and no head or chief is ever selected outside of the ranks and no one is promoted above the others unless for sufficient and explainable cause. The same routine of regular, sure promotion which is followed in military and bureaucratic life is also followed in the factory inspection department. There is also a continuity in the policy and work of the department due to the very few changes and to the long tenure of the heads of the departments. For nearly eighty-five years in England there were hardly half a dozen changes in the chiefs of the factory inspection department, and these mostly due to death and retirement. Compare these conditions with those in the United States. Here there is hardly a state where the tenure of office of the head of the department is longer than four years and usually it is two years. With every political upheaval and with a change in administration there is a change in the head, chief or commissioner of the department. In the thirty-odd years of the history of the New York State Factory Inspection Department, it has been ruled by a dozen or more chiefs, heads or commissioners. Scarcely is a labor commissioner or chief factory inspector appointed, hardly is he acquainted with his work, than he at once begins to expect decapitation. Under such conditions there cannot of course be any continuity of policy, any enlightened conception of functions, or an even-continued administration. Moreover, the commissioners, heads and chiefs are appointed more for their political affiliations than for their knowledge of the subject of factory inspection or their experience in similar work. Few of them enjoy the re-

spect of the rank and file of the inspectors or the confidence of the industrial population, worker or employer.

In very few states is promotion of factory inspectors from one grade to another regular, followed in due course and based upon justice. Very often when supervising or other higher class inspectors are to be appointed, the positions are filled by politicians and those who are *persona grata* to the powers that be. It is only a matter of several years since there was an earnest protest in New York State against the appointment of a janitor as supervising factory inspector, in spite of the fact that there were many inspectors among the rank and file who had earned promotion to the position by years of faithful work.

In order to improve factory inspection, we must put the status of the factory inspector on a higher plane. There must be some continuity in the higher personnel of the departments. Only qualified persons with knowledge and experience in the industrial field should be appointed as heads of departments, chiefs or commissioners, and when appointed should be kept, irrespective of political affiliations or changes. Promotion should be regular, gradual and based upon length of service and efficiency. No outsiders should be drafted into the department so long as there are persons within the department to fill the positions. The tenure of office of inspectors should be absolutely secure during good behavior; discharge only after a proper trial and with usual legal protection. Inspectors should be assured of pensions for old age and disability, which pensions should be liberal and sufficient for decent support. The pay of inspectors should be much higher. No inspector should be appointed with a salary lower than $35 per week, which should be gradually increased until it reaches at least $3500 per annum.

Only under such conditions will it be possible to raise the status of the factory inspectors in this country and to insure a proper selection and training of these useful officials so as properly to enforce labor laws and give real protection to the working population. The position of factory inspector requires no less ability and training than many public offices much more highly paid.

IV. QUALIFICATIONS, SELECTION AND TRAINING OF FACTORY INSPECTORS

Factory inspectors should possess the highest possible qualifications. They should be recruited from the most intelligent classes of the community. He who wishes to devote himself to the profession of factory inspection should be endowed with a good physique and robust health. He should have a gentlemanly bearing and be able to meet on an equal footing employers, superintendents and managers of the plants he inspects. He should be able to command the respect of employers, to gain the confidence of the employees and to earn the respect and confidence of the community. The factory inspector should have a good general education so as to enable him to stand on a basis of equality with the average employer and superintendent. He should have a prolonged training and experience in industrial work and should possess the practical knowledge of industrial conditions so necessary for intelligent inspection of factories and workshops. The inspector should go through special technical training in factory architecture, in the theory and practice of factory fire protection, lighting, ventilation and sanitation. A technical knowledge of machinery is necessary in order to enable him to inspect all kinds of machinery, to note absence of safeguards and to suggest improvements. The factory inspector also needs a thorough preparation and training in matters of industrial hygiene in order to be cognizant of the conditions leading to the deterioration of health of workers, and be able to promote industrial hygiene and sanitation. The inspector should also have a general knowledge of the various kinds of dust, their effects and methods of prevention; should know the different industrial poisons, their specific effects and means of prevention. Whenever possible an inspector should be able to speak the languages which the working population in his district use, should be able to make the technical tests for air, light and ventilation and should also have the ability to give talks and lectures to classes of workers and at educational institutions.

How far the average factory inspector in this country falls short of the above requirements I need not here add. Selection for fitness is still a rare method of ap-

pointment of factory inspectors in the states. Labor laws and factory inspection departments have been won from reluctant legislators by the efforts of partisan politicians and political labor unions, and when these laws were enacted and inspection departments established, the spoils usually went to the victorious politicians without regard to the necessary qualifications of the personnel.

In the report of the National Civic Federation, already referred to, the statement is made that in nearly every state reported no examination is required for appointment as inspector. There were a few exceptions among the states where the returns stated that a civil service examination is required. The report further adds that "the inference is that there is generally a prevailing defect in statutes which leaves the determination of what the statutory requirements as to inspection may be to personal or political interests."

In the report of the American Association for Labor Legislation, also already referred to, it is stated that only in Massachusetts, Minnesota, New Jersey, New York, Ohio, Wisconsin, Colorado and Illinois were inspectors under civil service. In the other states inspectors are either political appointees or are merely required to have had some practical experience, such as having worked in a shop, the other qualifications for inspection being determined solely by the appointive power.

No special technical training diplomas or educational qualifications are required from candidates for factory inspectors even in those states where civil service examinations have already been established on a firm basis. The character of the questions given in the various examinations is such that a person with no experience and with a little instruction may be able to cram the necessary knowledge within a few weeks and to pass a satisfactory examination.

The usual civil service requirements for experience are that the candidate shall have worked several years in an industrial establishment, which, of course, is no criterion of his education or technical knowledge needed for factory inspection. The questions usually propounded in the civil service examinations for factory inspector have mostly to do with the labor law and the industrial code, which may be learned by heart by anyone.

In contrast with the conditions prevailing in the United States, it will perhaps be interesting to describe briefly the methods of selection and examination of factory inspectors in several European countries. In all European countries the personality of the candidate plays a most important rôle, apart from any scientific education, technical training and other requirements imposed. The appointive powers in all countries select only those who have passed certain tests and examinations and also determine who shall take those tests. A system of nomination and appointment serves to exclude undesirable candidates, even those of superior education and technical training. Prussia and most Germanic states demand very high technical training while England only requires a certain number of inspectors to be technically trained men, the others being recruited from those possessing a high educational status. In France the inspectors are not all technically trained men although the examinations are more technical than in England and the technical branches form the most important part in the competitive examinations. In Austria, most of the inspectors are technicians, chemists, electrical or mechanical engineers. The countries which give most rigid examinations and tests are England, France and Prussia.

England.—In England only those candidates who make a formal application to the Private Secretary of the Home Office in London are considered, and only those who appear, after careful consideration and inquiry, to be the best qualified in every way for the position are given the opportunity to compete. Candidates are given one month's notice of examination. The age limit is between twenty-two and thirty, but may be extended to thirty-eight in case of persons having occupied positions of manager, foreman, etc., in engineering works. The candidate must pay a fee of 3 pounds (about $15) for the examination.

The subjects for examination are: Obligatory, English composition and arithmetic; and the following optional subjects of which four must be offered: English history; English literature; general modern history; French, German or

Italian; mathematics; economics, including knowledge of the history of industry; chemistry; physics, including mechanics, practical mechanics and industrial machinery.

The examination lasts about five days from 10 a. m. to 5 p. m., with an interval for lunch. The examination is written and oral. Oral tests are given in French, advanced mechanics, chemistry, and physics. The general appearance of the candidates is also rated.

France.—The age limit for applicants for the position of factory inspector in France is twenty-six to thirty-five, with no exceptions. Candidates must undergo a physical examination, must bring certificates of good character, etc.

The examination proper consists in: (1) A composition on labor laws wherein the candidate must show knowledge of all the labor laws and rules and regulations of the factory inspection department and also show acquaintance with the administrative and penal law and the forms of protocols, etc., used by inspectors; (2) questions relating to air and ventilation, heating, lighting, plumbing, water supply; dust dangers and removal, gases, fumes and poisons, infectious materials; labor; and extreme temperatures, humidity, compressed air, electrical plants, etc.; (3) technical examination in electricity, mechanics, labor machines and accident prevention; (4) knowledge of mathematics, algebra, geometry and trigonometry.

All tests must be finished in one day. Three hours are given for the compositions on law and one and a half hours for the other compositions. The oral tests are given about four weeks after the written examinations to those only who have passed the first tests.

Besides the oral tests a special practical test is also given. The first relates to industrial hygiene and applied mechanics and is given in the National Conservatory of Arts and Trades. Here each candidate is placed before an apparatus. He must describe the different means of ventilation, the drawing off of smoke, gases and vapors; explain the working of motors, machines, tools; and suggest provisions against accidents. Practical examination is also given in the laboratory, testing the candidates' knowledge of the use of various instruments, anemometers, hygrometers, psychrometers, the analysis of potable water, air, dust, etc.

Prussia.—Prussia is the most severe in its requirements for candidates for factory inspector. Prussia demands from a factory inspector the following: (1) A certificate of graduation of nine classes of gymnasium; (2) three years' technical study in a German high school; (3) one and a half years' study of law and political science. These are the preliminary requirements. Candidates passing these are then subject to two examinations and a period of probationary work in the industrial inspection department. The two examinations are respectively at the beginning and at the end of the probationary service. The first examination may not be required if the candidate has the qualifications of a state machinery construction master, a mining, technical or chemical engineer. The main examination is oral and written and is conducted by a board of supervising officials in Berlin, especially appointed for the purpose. The questions relate to administration of the industrial code and political science and to administration. *The candidate is given six weeks' time in which to answer the questions, which period may be extended to two months.* The oral examination consists of questions which tend to show the ability to determine and solve technical problems of practical service. The examination determines the knowledge of the candidate of the constitution of the German empire, Prussian state, state administration, industrial code, etc. It also goes into the understanding of the methods of safeguarding machinery, principles of construction of factories, methods of heating, ventilation and sanitation. The candidate is required to have a knowledge of prevention of accidents, prevention of dangers to health in industries and the danger of certain industries to neighborhoods; likewise a thorough knowledge of the Industrial Code and the Workmen's Insurance Code is required. A fee of 50 marks is charged for the examination.

After passing his first oral and written examination the candidate is appointed for probationary service, is considered an industrial referendum, and is put under the immediate supervision of an industrial assessor inspector, who acts as his pre-

ceptor and under whose direction the candidate pursues his work. *The service lasts one and a half years.* It consists, first, in clerical work and learning of all the industrial bookkeeping, etc., used in factory inspection offices, which training is then followed by the candidate accompanying the inspector on his tour of factory inspection. This period lasts nearly a year. During the last three months of the probationary period the candidate is required to learn the routine work of inspection in its relation to the government, preparation of reports, etc. During all this probationary period the candidate receives no salary.

At the end of the probationary period the candidate is required to write a thesis to show his knowledge of industrial hygiene and sanitation and his ability to solve problems arising in factory inspection.

It is not here advocated that we, here in the United States, should adopt the same rigid requirements which have proved so satisfactory in European countries. Nevertheless, there is a distinct need of undertaking definite measures to supply the necessary knowledge and technical training to candidates for service in factory inspection departments before their selection for these positions. There may also be need to continue the technical training of inspectors during at least a year or more of their first period of service in such a department.

There is much reason for advocating the introduction of a special course for the training of factory inspectors in the high schools, in colleges, and especially in technical schools and engineering departments of universities. The provision of facilities for special study for those desiring to enter the profession of factory inspection would redound to the benefit of the cities and states in which they were introduced, would raise the status of factory inspectors and would tend to fill the ranks of factory inspectors with highly qualified and specially trained inspectors.

As far as I know there are no state labor departments and factory inspection bureaus that attempt to give a technical training to newly appointed factory inspectors. In New York State an attempt was once made by the Labor Department to give a few lectures to the factory inspectors, but this has seemingly been abandoned. There are sufficiently trained men in and out of the factory department who could give the needed instruction to new candidates and there is abundant material in these departments to teach the new inspectors the methods of factory inspection and the knowledge of various specialties in industrial hygiene and sanitation.

In concluding this paper it may be of interest to state that a course in industrial sanitation is to be given by the writer of this article during the first semester of the 1920 course of the New York School of Social Workers. This course succeeds two previous courses given by him on the same subject in the Extension Department of the New York City College during the years 1917 and 1918.

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HERNIA IN INDUSTRY *

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DATA on the physical examination of prospective employees reveal the fact that approximately 3 per cent. of the men offering their services to the industries have well developed inguinal hernias; approximately 14 per cent. have incipient hernias. Hernia occurs with sufficient frequency to be regarded as the greatest single frailty of the American worker. The oblique inguinal type comprises over 92 per cent. of all hernias encountered.

THE EMPTY HERNIAL SAC

The preliminary physical examination sometimes fails to disclose the presence of an existing hernial sac. A hernia is a protrusion, the essential part of which is the hernial sac. The lining membrane of the body cavity is the peritoneum, and the hernial sac is a process of peritoneum shoved out from the body cavity, serving as a pocket for the reception of portions of omentum, intestine, or other abdominal organs. The hernial sac, serving as a receptacle for hernial contents, may remain empty for years. The palpating finger of the examining surgeon can not feel the empty hernial sac. When the sac fills, however, the examining surgeon readily feels the fluid or solid contents which distend the sac. Fluid serves as a hydrostatic dilator of the pre-existing sac, until it is sufficiently distended for solid contents to enter.

The hernial sac which has acquired solid contents, as a rule, will spontaneously empty itself when the individual lies on his back in bed. Solid contents may not enter the hernial sac every day, and the individual may assume that the hernia has disappeared. Hernial sacs may fill and empty themselves many times, and persons afflicted with them may not have observed the hernial mass. Honest men, in perfectly good faith, having thus developed their hernias, may deny that they are suffering from hernia. Again, the individual examined may be disinclined to relate the whole truth, though he knows very well that coughing, sneezing, straining at stool, some kinds of work, may bring down his hernia; he rather gloats over the fact that he has "put something over" on the doctor, in having "gotten by" with his hernia.

While applicants with hernias are not refused industrial employment for which they are qualified, the physical examination records should include the tabulation of existing defects, such as hernia, as a guide to classification for suitable employment. There are other defects besides hernia, which an applicant for employment may advertantly or inadvertantly conceal from the examining physician. The empty sac, which sometimes fills, but which does not fill easily, is thus a source of diagnostic error, especially when the person examined willfully, or ignorantly, misleads the examiner. The surgeon, finding no mass in the sac at the moment of his examination and none appearing on exertion, merely records "relaxed ring," "hernial canal admitting one finger," or "two fingers," and considers the individual as a suspect, placing him in the "incipient" class.

The hernial canals may appear closed, and yet hernia may arise; conversely, the hernial canals may be relaxed, and no hernia develop. In short, the patulousness of the hernial canal, depending on the size of the aperture in the aponeurosis of the external oblique muscle, is incidental; the wide-open external ring, and the deficient fascial and muscular support of the inguinal canal, may, however, contribute to the rapid development of an existing hernia. Patients having tight external rings may simultaneously have relaxed internal rings; in such instances, no assistance in arriving at a correct diagnosis is obtained by palpating along the course of the cord —the palpation must be through the abdominal wall, as in the case of direct hernia. When there is a tight external ring and thick subcutaneous tissues super-

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imposed over a relaxed internal ring, the examining surgeon may fail to detect an incipient hernia at the internal ring. The predetermining cause of the acquired hernia in any event is the unrecognized empty hernial sac.

The diversity of opinion among competent physicians as to the existence, or non-existence, of a hernia usually hinges on the fact that nobody can palpate an empty hernial sac. Examine the patient to-day, he has a hernia, as the hernial contents distend the hernial sac. Give him a cathartic, let him rest up, and to-morrow you may not know on examination, and your colleague cannot definitely ascertain, which side to operate. As hernia is usually a bilateral anatomical defect, in cases where there is doubt, it is best to do a double herniotomy.

The industrial surgeon is sometimes censored for his inability to detect which applicants have, or have not, hernias; or will, or will not, develop hernias. As the empty hernial sac cannot be palpated, and as the man with an incipient hernia, when out of work, will have his hernial sac empty, no series of physical examinations can be absolutely correct on the score of hernia. Examples of diagnostic error are numerous, of which the following are typical:

"G" was operated for a left oblique inguinal hernia by a reputable surgeon, who told him he had no hernia on his right side. He recovered and returned to work, working one-half day, then developed a mass in his right groin. On operation, the right hernial sac was large, thick and had many adhesions. His bilateral hernia was a congenital defect, as proved by the findings at operation, though the patient had reached middle life before the developmental defect became manifest. Contents must enter the empty hernial sac before the definite diagnosis of hernia can be reached by the palpating finger of the surgeon.

"I" was an infant of eight months, admitted for herniotomy. The family physician had succeeded in reducing the hernia by manipulating an hour, but he forgot on which side it had appeared. No contents entered the hernial sac when the child cried, and as the inguinal canals were wide open on both sides, the operating surgeon did not know which side to operate.

"H" A letter in my possession declares that a certain patient was paid three times, by three different firms, for a right oblique inguinal hernia, under the compensation law of New York State. We are not conversant with all the facts of the case, but such a situation is a possibility, unless the radical cure by surgical operation is resorted to when the hernia first develops. A hernial sac with a narrow mouth, which is infrequently filled, offers this possibility.

"F." This patient was sent to the hospital with a bilateral hernia, large masses in both groins, almost scrotal in extent, and with the contents of the sacs easily reducible. A diagnosis of double hernia was made while the patient was at work. Two days later in the hospital, after the patient was purged and rested, he had a small hernia on the right side and no hernia on the left. On operation we found large hernial sacs on both sides —sacs thick and adherent and of congenital type. On repeated occasions we have found hernias down while men were at work, but could not confirm the diagnosis of hernia by palpation after the men had rested up, but on operation found large, thick adherent sacs, indicating that the hernias had existed a long time.

Such findings at operation have led us to consider the preformed sac a pathological entity, and to regard a hernia into a preformed sac as a disease, irrespective of the circumstances accompanying the first appearance of the mass in the groin.

The Hernial Sac Is Pathological

The hernial sac is preformed, occurring as (a) a congenital malformation, or (b) an acquired defect.

(a) The pre-existing sac is an embryonal remnant, and is consequently present for years before the advent of the hernial contents within the hernial sac. The processus vaginalis, having failed to atrophy, leaves as an anatomical defect, an empty hernial sac; the patulous processus vaginalis, constituting the preformed sac, is the pathological entity responsible for the advent of many hernias.

(b) The dimple of peritoneum at the internal ring may deepen, and extend along the perivascular spaces; or the protrusion of peritoneum may arise owing to weak fascial and deficient muscular support. (The direct inguinal hernia results from relaxed fascial support.) The acquired hernial sac arises slowly, because the peritoneum is a tough, resistant membrane, and can not be pushed out to form a sac by any single impulse. This is readily demonstrated on the cadaver; no finger is strong enough to push out the peritoneum suddenly at the internal ring. Yet nature permits the gradual stretching of the peritoneum without tearing it, as in the acquired type of hernial sacs.

MODE OF ONSET

The usual mode of onset of hernia is with backache, and discomfort in the groin, but the patient does not often see fit to stop work when the mass first appears. The hernial mass may appear now

and then for weeks, or months, before the patient reports it to a physician; the mass may even be unobserved by the patient until almost scrotal in extent, and is often first discovered by a physical examination. On the other hand, through fear of operation and for other personal reasons, its presence is often concealed by the patient, or if known may not yet have received enough solid contents to cause him concern. Less frequently, the mass causes sufficient pain to induce the patient to see a physician at once, and to necessitate his stopping work.

As is well known, water (peritoneal fluid) serves as a hydrostatic dilator of the preformed sac, until the sac is sufficiently dilated to admit solid contents. No mass appears until the later stage is reached, when solid contents enter the sac. With each increase in the solid contents of the sac, there is likely to be added pain and discomfort. In our experience, it is the aggravations of old hernias, rather than the incipient stages of recent ones, that produce discomfort and disability.

Just as a house is a house before it becomes tenanted, even so an empty hernial sac constitutes a latent hernia, before the said preformed hernial sac acquires contents. The owner of the empty hernial sac is blissfully ignorant of its presence, until the hernial sac fills, or is about to fill. When the preformed hernial sac acquires solid contents, the hernial mass leads to the discovery of the previously unrecognized hernial sac. The building of a house is gradual; acquired hernia, as encountered in the industries, is likewise a gradual process, and while its discovery may come as a surprise to the patient, it has really been a longer time on the way than he knows of.

ETIOLOGICAL FACTORS

The empty hernial sac invites hernial contents, and is the determining factor in the causation of hernia. Other predisposing and exciting factors are: (a) Deficient fascial and muscular support about the cord; and (b) Increased intra-abdominal pressure, as from respiratory diseases—coughing and sneezing; intestinal diseases—constipation and tenesmus; genito-urinary diseases—stricture and vesical tenesmus; obesity, etc. Wearing a belt operates in a similar manner to increase the intra-abdominal pressure, and the consequent *vis a tergo,* which forces the hernial contents into the previously prepared hernial sac. With the hernial sac prepared for a tenant, any sudden increase in the intra-abdominal pressure, as from violent sneezing or coughing, may fill the sac.

The tendency to hernia may be accelerated by heavy work, requiring pulling, pushing or lifting; especially may persons long unaccustomed to such work, upon turning to heavy work, develop latent hernia. Hernia, however, is not an occupational disease, but a disease in the category with hemorrhoids and varicocele, arising from an anatomical defect. The worker at heavy labor develops strong muscles and tough fascia, which protect him in some measure from hernia, and is less liable to acquire the disease than the sedentary worker with flabby muscles and relaxed fascia, who sneezes, coughs, strains at stool, and occasionally does heavy work.

At most, occupation is only one of the exciting factors in the causation of hernia, the determining cause being the preformed sac. The hernial sac may fill for the first time when a worker is lifting, pushing, or pulling; the tenseness of muscular strain may coincide with the psychological moment for the filling of a preformed sac. If, however, the findings at operation reveal that the preformed sac existed, it is a pathological hernia, not a traumatic one.

TRAUMATIC HERNIA

A hernia is a protrusion; hence, there can be hernia of the brain, and of the lung, as well as of the abdominal viscera. A traumatic abdominal hernia is not confined to the hernial zones, but may arise wherever sufficient external violence is applied. In the truly traumatic hernia, the peritoneum is torn; there is no sac, the viscera came out through a fresh tear in the peritoneum. Direct injury, such as might be caused by the horn of a mad bull, or by the tongue of a wagon drawn by runaway horses, inflicting sufficient violence to the physical structures of the body, may produce a traumatic hernia at the site of the focal trauma.

Falls from high structures often cause

multiple fractures, and ruptures of internal organs, but seldom give rise to traumatic hernia. A violent squeeze, such as occurs when a railroader is caught between a moving car and a station platform, it is stated, may so increase intra-abdominal pressure, as to tear the peritoneum and cause a true traumatic hernia. So infrequent is traumatic hernia, however, that many industrial surgeons of wide experience have never encountered one.

In preparing a paper on "Hernia as an Anatomical Defect," for the Pennsylvania Conference of Physicians, in 1916, and again as Secretary of the Hernia Committee of the National Safety Council, 1917, the writer exchanged opinions with scores of noted general surgeons and leading industrial surgeons, particularly to get their viewpoint on hernia as ordinarily encountered in industry. Hernia is to be classified as a disease, in the unanimous opinion of these surgeons, except the rare cases of genuine traumatic hernia, as herein described.

We will quote but one, Dr. Charles H. Mayo, who says:

"I believe, as you do, that there is an anatomical defect in the individual who develops inguinal hernia following straining or accident—that he has a congenital protrusion of the sac along the cord. A true traumatic hernia, if inguinal, is nearly as much of a local injury as if it were produced on the abdomen in other regions. It should be accompanied by such local evidence of its occurrence as would be expected from injury of the parts."

STATUS OF EMPLOYEES WITH HERNIA

Industry, no less than the army, classifies the victim of hernia as subnormal. Without a truss, there is no assurance against the rapid increase in size of the hernia. The truss pinches, chafes the skin, and hurts the patient; but if loosely adjusted, the truss, in spite of its presence, permits the escape of the hernial contents into the sac.

The frequent failure of the truss to retain the hernia in reduction; the hernia continuing to increase in size in spite of a truss; the hernial contents distending the hernial sac and being pinched under the truss; the adhesions so often existing between the walls of the hernial sac and the hernial contents, making the wearing of a truss uncomfortable and dangerous; the sliding and slipping of a truss; and its rapid deterioration, all make a truss a temporary makeshift, applicable for a season, where operation is necessarily deferred, and a necessary evil where operation is contra-indicated, as for certain recurrent hernias.

The victim of hernia has been told about incarceration, and strangulation, but is willing to "take a chance." Through compensation enactments, the financial burden of the extra hazard is in a measure transferred from the chance-taking employee to the industry employing the individual suffering from hernia.

Hernia interferes with production. The employee with hernia can not put his native energy into the work; in lifting, pulling, and pushing, he does not do his share, but is disposed to shirk; he always wants to be placed on some easy job, where he will not have to work hard. The patient with hernia has difficulty forgetting himself in his work; his mind is off his work, and on his hernia, hence he is a more efficient worker after his hernia has been repaired.

RESPONSIBILITY FOR HERNIA

An acquired hernia is a disease. The acquired hernia is popularly confounded with true traumatic hernia to so appalling an extent that more cases of alleged traumatic hernia have been awarded compensation in Pennsylvania (exceeding 4000) than there have occurred cases of real traumatic hernia in the western hemisphere since Columbus discovered America. Other commonwealths have been as notorious in awarding compensation for acquired hernias, pathological in type, which are in no sense true traumatic hernias.

Yet when a hernia arises during industrial service, regardless of the etiology, we contend it should be relieved by truss, or repaired surgically, and the affected individual restored to industry. The practical economic problem arises—at whose expense should trusses be fitted, and herniotomies performed? The company's surgeon can do the herniotomy and radically cure the disease in less time than is wasted in legal quibbles over "who is responsible?"

How can the patient be responsible? He was unaware of the pre-existence of the hernial sac, until the filling of that hernial sac with hernial contents occurred. The general public, and some lawyer, then convince the patient that "he must have sustained some injury of the nature of a strain," and that "in consequence of said strain he developed a hernia."

How can the employing company be responsible for anatomical defects that lead to hernia? As surgeons, we are concerned in the cure of the victims of hernias, and would rather operate than argue; and because we know that the patients need relief, and the employing companies require their services, and their good will, we advise operation.

For the truly traumatic hernia, the employing industry is undoubtedly responsible under the Workman's Compensation Act, but less than one hernia in a thousand is of this type, hence, the 999 constitute a burden imposed by law on industry.

DIAGNOSIS AT OPERATION

In a *bona fide* traumatic hernia, there is hemorrhage, ecchymosis, torn structures showing the hernial contents escaping through a tear in the peritoneum. In the common, acquired hernia, the surgical dissection of the structures involved shows no torn structures, no hemorrhage, nor ecchymosis, and the hernial contents occupy a preformed hernial sac. The extent of this preformed sac, its thickness and its adhesions, offer more convincing testimony as to the anatomical defect, which is responsible for the hernia, than can be adduced from other sources. The time and manner of onset, when the patient first felt pain or noticed the mass, are, in comparison, irrelevant and immaterial.

The findings at operation are paramount in determining whether any given case of hernia is pathological, or traumatic. The operating surgeon and his immediate assistants are consequently the most competent witnesses in describing the findings in any given case. The surgical diagnosis, based on the findings at operation, we have therefore contended, should, to a greater degree, guide the referees under the Compensation Acts, as to which cases of hernia are pathological, and which are traumatic.

Straddling the Issue

Ohio, New Jersey, and certain other states, provide that the industry pay surgical expenses and compensation for a certain group of pathological hernia, in addition to paying for *bona fide* traumatic hernias. The group of pathological hernias thus imposed on industry must fulfill the following five points:

"Hernia is a disease which ordinarily develops gradually, being very rarely the result of an accident. Where there is real traumatic hernia resulting from the application of force directly to the abdominal wall, either puncturing or tearing the wall, compensation will be allowed. All other cases will be considered as either congenital or of slow development and not compensable, being a disease rather than an accidental injury; unless conclusive proof is offered that the hernia was immediately caused by such sudden effort or severe strain that, first, the descent of the hernia immediately followed the cause; second, that there was severe pain in the hernial region; third, that there was such prostration that the employee was compelled to cease work immediately; fourth, that the above facts were of such severity that the same were noticed by the claimant and communicated to the employer within twenty-four hours after the occurrence of the hernia; fifth, that there was such physical distress that the attendance of a licensed physician was required within twenty-four hours after the occurrence of the hernia. In the case of hernia, as above defined, compensation shall be paid, etc., etc."

This quotation is from the New Jersey law of 1919, and suggests the lines along which it is proposed to change the Compensation Act in Pennsylvania. Beginning at the phrase "unless conclusive proof is offered," the framers of this act straddle the question. Why require employees to frame up such a symptom complex in order to have their hernias operated? Why hold out the bait of compensation benefits for only one group of pathological hernias?

The law as amended will still enable claimants, who acquire hernias, to offer "conclusive proof," as it assumes that the filling of a preformed sac constitutes a traumatic hernia. Our contention is that the findings of the operating surgeon

should have some status before the referee. When at operation the sac is found to be preformed, and either of the congenital or acquired type, the hernia is not truly traumatic, even though the increase in its size may have occurred in a manner to satisfy the five points as adopted in certain states, and as proposed for incorporation in the compensation acts of other states. Under the changed law, the chief reliance is placed on subjective symptoms, as heretofore, instead of depending on objective signs, as revealed by the scalpel of the surgeon. With pantomime and proper staging, the "five points" could be simulated in a manner to make employers liable for almost all hernias, and is no better than the present arrangement—worse in that it puts a premium on malingering.

We suggest operation at the expense of the employer, yet omitting the payment of compensation for pathological hernias, as a measure of policy calculated to restore such workers to industry, without compromising their integrity. This arrangement would be a compromise, which would be less onerous to the employer, and abundantly fair to all employees, not alone to the limited group who allege a sudden filling of preformed hernial sacs, as advocated under the present proposal.

Repair All Hernia

Where a reasonable presumption exists that the employee's hernia has arisen in the course of his employment, our company accepts the patient's viewpoint and repairs the hernia without expense to the employee. When the patient knows that he will be cared for surgically, in any event, it is not necessary for him to frame up the "five points," as above recorded.

The established attitude of many industries toward hernia, where occupation is even a remotely contributing factor, is, thus, to repair surgically all hernias amenable to this type of treatment and to provide trusses where herniotomies are contra-indicated.

Operating practically all hernias that arise does not constitute an acceptance of liability for the payment of compensation benefits, but affords an early termination of such liability, if such liability is shown to exist, by early restoring the claimants to industry. Our contention is that the employer is quite reasonable in assuming financial responsibility for operating acquired hernias, where occupation is assumed to be a contributing factor in their development, and should not, in addition, be expected to pay compensation benefits for disability arising therefrom.

We are convinced, moreover, that performing herniotomies for pathological hernias should be regarded as a gratuity on the part of the industries, calculated to restore faithful employees to industry, and, at the same time, as a patriotic duty by which industrial workers are restored to their greatest efficiency.

THE OCCURRENCE, COURSE AND PREVENTION OF CHRONIC MANGANESE POISONING *

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THE commercial uses of manganese are many, but instances of poisoning have been collected from only three sources. This is possibly because the condition is rare and the symptoms so bizarre that the physician unacquainted with the possibility of poisoning by manganese and seeing a single isolated case, interprets the findings as an atypical instance of some more common type of nervous disease.

A partial list of the uses of manganese compounds in this country and abroad is as follows: It has been employed in the manufacture of chlorine and oxygen, in making dry batteries, in glass works for cleaning and coloring molten glass, for coloring brown and black glasses, to destroy carbon in the production of enamel, as a paint for Fayence and porcelain, for glazing, for coloring and graining soaps in aniline and alizarin factories, in various processes connected with the manufacture of glass, oil, and varnish, and finally in the making of cement and glazed brick. Certain manganese colors, such as manganese brown, an hydrated peroxide of manganese, have had extensive use. Manganese bistre and manganese violet are other examples of dyes made from this metal. In Holland and Germany manganese sulphate has occasionally been used as a fertilizer, but not very widely, the matter having been apparently in the experimental stage when the war began, and finally manganese has been extensively used as an alloy with steel and nickel.

In spite of these very varied applications of the metal, chronic poisoning is known to have occurred in only three types of employment:

1. In French workers handling manganese dioxide in the manufacture of chlorine for bleaching powder.

2. In Germans engaged in grinding manganese dioxide as a stage in commercial utilization for various purposes.

3. In mill employees in the United States who work in a dust containing manganese as oxides and silicates.

HISTORICAL SUMMARY

The history of the occurrence of chronic manganese poisoning is most interesting. Couper (1) in 1837 published a brief article recording observations on five workmen all employed in a chemical factory where they ground manganese dioxide in the manufacture of chlorine for bleaching powder. "Their skin is constantly covered with a layer of the oxide, and the air which they breathe is impregnated with a multitude of molecules of this oxide which are introduced into their lungs by respiration. In 1821 a young man apparently in good health, being employed at this work, presented symptoms of paraplegia which, becoming worse, forced him at the end of some months to stop work. After having tried without effect the medicines used in paralysis, he absented himself from the neighborhood for a year, and at the end of this time, having returned, it was evident that he had made little progress toward recovery. In the following year another workman, similarly employed in grinding manganese and apparently enjoying the best of health, fell equally ill. It not being suspected that manganese produced poisonous effects, he was permitted to work for several months, with the exception of short intervals employed in treatment. As the paralysis increased, manganese was finally suspected to be the cause and the workman moved to another region. After this time there was no augmentation of symptoms and at the end of

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six years the patient was in good health. During the height of the disease the weakness of the contractile muscles was much greater in the legs than in the arms. It was of such nature that the patient reeled in walking and leaned forward when he wished to walk. The arms were somewhat weak and there was difficulty in speech. He was not able to make himself understood by a person at a little distance. Other sensations and intelligence were unaffected. The trunk muscles had the appearance of a paralytic. Saliva ran from the mouth during speech. There was no trembling of any part of the body, no colic, constipation nor derangement of digestion. He was given mercurials, vesication of the head and dorsal spine and strychnine, but all without effect."

Following these two cases three others developed, but when these men were promptly removed from their work, the early symptoms which they displayed disappeared.

Many years then elapsed before manganese poisoning was again described. On October 7, 1901, R. von Jaksch (2) described three cases which he considered atypical instances of multiple sclerosis of the brain and spinal cord. Von Jaksch described these cases very carefully and commented upon the fact that they were all employed as grinders of manganese dioxide in the same factory and that they all attributed the disease to their work. He was evidently unwilling, having failed to note Couper's (1) publication, to fasten such an extraordinary disease picture upon manganese and finally made the diagnosis of multiple sclerosis and believed the inordinate changes in temperature to which these men were subjected to have been the direct cause of their disease.

A summary of the history and physical examination of one of von Jaksch's patients will be of interest and should be compared with the history and physical examination of the typical American cases.

Von Jaksch's Case

History.—M. J., a workman aged 19 years, with an unimportant family and previous medical history, was first seen on Jan. 31, 1909. This patient had been employed from March, 1900, until Dec. 18, 1900, in the drying of manganese dioxide slime, the process of which was as follows: The slime was pressed, washed with water and in the form of cakes consisting of 60 per cent. water, 2 per cent. calcium salts, and the remainder rectified manganese dioxide, was spread out on large plates and heated to 100° C. M. J. together with the other two patients of von Jaksch had to break up lumps of this material and stood on the plates in wooden shoes to do it. A great deal of dust accompanies this operation (3). On Dec. 4, 1900, the patient noted a certain weakness of the legs which made walking difficult. Two weeks later he experienced a sudden trembling and shaking of the arms and legs and about the middle of January his gait became as it was at the time of examination. He felt stiffness in the knees which made pronounced bending of the legs impossible. At the same time he found he could not walk backward without falling and speech became noticeably slow.

Physical Examination.—On Feb. 3, 1901, a general physical examination proved quite negative, heart, vessels, lungs, abdomen, development, color of skin, etc., being normal.

Course of the Disease.—On Feb. 5, 1901, the patient exhibited very marked uncontrollable laughter occurring without any cause; long words were spoken with difficulty; he was able to count from one to ten and back monotonously but accurately, and seemed quite sound mentally. His pupils were equal and reacted normally and no nystagmus was recorded. The outstretched tongue moved slightly to the right; movements of the arms were somewhat uncertain but fine movements of the fingers were well made; there was a marked tremor of the right hand when the arm was outstretched, and the grip was strong. There was no ataxia of the legs; the patellar reflexes were increased; moderate ankle clonus and Romberg's sign were present; and the patient could not stand on the right or left foot alone. There were no sensory disturbances of any kind.

The patient left the clinic on Feb. 12, 1901, but his condition, especially his speech and gait, became worse and he came back to the hospital on April 20, 1901; his gait was spastic and he indulged in constant motiveless laughter. On April 22, 1901, he still showed uncontrollable laughing and crying and fatigued greatly in walking. Bilateral ankle clonus was present and the knee jerks were much increased. On May 3, 1901, he was discharged with no mention of improvement.

The other two patients described by von Jaksch worked with manganese in the first instance six months, and in the second eighteen months before showing symptoms which are quite similar to those we have quoted.

H. Embden (4) on Oct. 15, 1901, described two patients in an address to the Medical Society of Hamburg and later in the same year reported these cases with two others in the communication to which reference is given. These cases he diagnosed correctly as chronic manganese poisoning. All occurred in men engaged in grinding manganese dioxide, after sev-

eral months' exposure to air filled with very fine dust. To the symptoms already enumerated Embden's account adds:

"Considerable tension in repeated active and passive motions. Increased tonus of facial muscles, mask-like appearance. . . . On stepping downstairs, the patient is compelled, after losing control of several steps, to take two or three plunging steps forward . . . . In writing, marked disturbance occurs in some cases, tremor in any case, caused by the increased tension of the muscles concerned in the course of action. There is a continual diminution of the letters until after a few words or lines the writing becomes illegible . . . . Edema of the lower extremities was observed. . . . One patient, who earlier had normal speech, developed later with the other symptoms, marked stuttering."

In 1903 Friedel (5) and Seiffer (6) reported the most characteristic of the foreign cases, and Seelert (7), in 1913, gave a very complete review, not only of Friedel's original findings in 1903, but of the condition of the patient in 1913. His article is illustrated and gives an excellent idea of the entire condition. Seelert's work, together with two other papers by von Jaksch (8), (9) sum up the fifteen cases of manganese poisoning described in Europe.

Seelert's patient presented in summary the following findings:

SEELERT'S CASE

History.—The patient, R. B., was a married man aged 44 years, and the father of six healthy children, three of whom were born after the beginning of his illness. His previous medical history was negative. From the autumn of 1898 to the end of 1902, R. B. had worked as a grinder in a manganese dioxide mill. After one year's employment "a faintness and fatigue came upon him, which gradually increased to heavy lethargy so that the patient fell asleep as soon as he lay down, and at every available time, even in the one-hour noon recess." A little later involuntary rhythmic nodding of the head began, attacks of this nodding appearing without warning and lasting uninterruptedly for a few minutes. Bodily movements became slow and awkward though muscular strength remained good. In March, 1901, he noticed that his voice was low and toneless. Uncontrollable laughter and weeping appeared in the early part of his illness. He continued to work until the end of 1902, when he gave up his job.

Friedel (5) described the condition of this patient in 1903 as follows:

"February 17. Out of the open mouth clear saliva flows constantly in great quantity. The facial expression is that of a rigid, constant smile. The speech is low, monotonous, disjointed, and almost unintelligible. The gait is heavy and awkward with a slight forward propulsion, the upper part of the body swaying unsteadily. The general appearance is that of old age. Patellar reflexes are unchanged, the light reflex preserved. During the examination, the lips and cheeks began to show fibrillary tremors and at the same time there was a clonic spasm of the neck muscles which moved the head in slow rhythmic shaking movements about a vertical axis.

"February 25. Urine free from albumin and sugar. Sputum examination negative.

"April 24. Urine examined for manganese with negative result, a finding not surprising since the patient had not worked in the dust for four months.

"On repeated examination during 1903, there has been no evidence of any sensory disturbance, no disorders of the bladder nor rectum, and no loss in power nor electrical irritability of the general musculature. Also the Romberg and Babinski phenomena have been constantly lacking together with every trace of ataxia and every sign of psychic derangement, apart from the uncontrollable laughter and crying. Pupillary reactions, fundi, visual fields, and eye movements have been normal throughout. Only after persistent looking to one side does the slightest nystagmus occur."

Physical Examination.—Examination in 1905 and 1906 showed no change in the condition of the patient. Seelert (7) in 1913 found a striking rigidity of the muscles throughout the entire body. The following description contains the important points in Seelert's own account of the case:

"The patient's features with the wrinkled skin about the eyes and the wide open mouth have continued in a fixed smile, which goes over into uncontrollable laughter from trifling emotional cause. In the same way low weeping frequently occurs. These emotional explosions are distressing to look upon and the patient is incapable of interrupting them. Their intensity stands in no proportion to the accompanying emotion.

"The ability to use opposing groups of muscles quickly and alternately is disturbed. In walking the legs are rotated inwards. The feet touch the floor only with the region of the metatarso-phalangeal joint. The patient is able to walk flat-footed, but after a few steps the tendency to abnormal placement of the foot appears. During walking he is incapable of stopping immediately at a command, but retropulsion is much stronger than propulsion. There is awkwardness in finger and arm movements but no loss of strength, and no alteration in electrical nor mechanical irritability of the muscles. There is no ataxia and no intention tremor, though a quick tremor of the hands is present.

"Periosteal and tendon reflexes in the arms are vigorous, patellar and Achilles tendon reflexes equally so. There is a suggestion of ankle clonus. Sensation is altogether normal. No eye-ground changes nor alterations in color or form fields. Pupillary reflexes and ocular movements normal.

Sensations of hearing, smell and taste normal.

"Speech is indistinct, monotonous, low and has little timbre. There is no scanning nor hesitation. The vocal cords are normal. No psychic disturbances at the present time." (Uncontrollable laughter and crying were recorded in 1903 but were apparently non-existent ten years later.)

Laboratory Findings.—The urine was free from albumin and sugar and there was no alimentary glycosuria nor levulosuria. The Wassermann reaction was negative. Blood pressure was normal.

Seelert (7) sums up his experiences and those of other foreign workers as follows: "The symptoms which the patient presents remind one very much of severe cases of multiple sclerosis, but the diagnosis of manganese poisoning may be maintained because of the complete identity the disease has with all original cases. In every instance it has occurred in men who were employed in the manganese dioxide industry. In all, the symptom of stiffness of the musculature is prominent with the same secondary appearances, aggravation of active and passive flexibility, retropulsion and defect of speech. Von Jaksch described the peculiarity of gait our patient presents so markedly. There have never been any sensory disturbances, nor any involvement of bladder and rectum."

Casamajor (10), in 1913, described nine cases occurring in workers in an American mill and it is from this same mill, driven to extreme intensity of production as a result of the war, that our cases, with one exception, have come. Casamajor's experience, as in the case of the foreign authors, was altogether with advanced stages of the disease. His description of symptoms is very complete and includes reference to entirely negative findings in the blood and urine, as well as in the spinal fluid.

CAUSATION

The fifteen foreign cases have invariably occurred in men exposed to manganese dioxide. One American patient developed the disease as a result of eight months spent in shovelling Japanese manganese ore into a hopper, an extremely dusty task. This ore contained manganese as manganese dioxide. The remaining thirty-eight cases, comprising all men presenting suspicious or definite symptoms with whom we have had contact, have occurred as a result of work in dusty parts of a mill engaged in separating manganese from other ore. The crude ore from this mill contains 9 per cent. manganese, combined as oxides and silicates. It is significant that lead never appears in the crude ore except in the most minute traces and arsenic is entirely absent.

The process of separating the manganese is a dry one, the manganese and iron fractions being removed early in the operation by the use of very large magnetic separators. The mineral dust is carried on wide conveying belts between the poles of extremely powerful magnets. The iron- and manganese-containing particles at once move toward the nearby magnetic pole, which they are prevented from reaching by a second conveying belt, passing between them and the pole in question. They cling to the under side of this conveying belt until carried outside the main strength of the magnetic field, where they fall into a hopper. The ore dust must be extremely fine and dry to lend itself successfully to such an operation and in the drying, conveying, and separating there are large opportunities for impregnation of the atmosphere with dust. The amount of dust in the air has been greatly reduced by the introduction of an elaborate suction and bag filter system.

Casamajor (10) has called attention to an article by Schlockow (11) describing a peculiar and very slowly developing condition of poisoning in Silesian miners working with ore containing zinc and manganese, but with lead and arsenic also present. This description does not resemble manganese poisoning, nor has zinc in any form ever caused nervous symptoms of even remotely similar character. One has great difficulty in visualizing the disease picture presented by Schlockow but a combination of the known effects of lead and arsenic might possibly cause the syndrome which he described.

Portal of Entry.—Workers in a dusty atmosphere both inhale and swallow dust particles. In the case of lead it is apparently possible to develop poisoning through lung absorption alone or practically alone. Chronic poisoning with manganese, however, has never occurred so rapidly as with lead. In one instance we have knowledge of definite symptoms after one and one-half months' work. The most rapid development of permanent crippling either in this country or abroad

has required four months and five days' exposure to a dusty atmosphere. With such a rate of poisoning it is probable that absorption of manganese occurs both from the lungs and from the gastro-intestinal tract. The ore in question is readily soluble in the hydrochloric acid of the gastric juice (12). Particles reaching the lungs are undoubtedly coughed up and swallowed, together with an infinity of other particles which are swallowed directly. Reaching the stomach, the manganese is converted into manganese chloride and absorbed. Wichert (13) showed that soluble manganese salts are excreted in the bile. Kobert (14) and Cahn (15) found manganese in the stomach and intestinal contents after subcutaneous injection of soluble salts in rabbits. Harnack (16) found excretion of manganese into the intestine, manganese in the bile and a small amount in the urine—the latter fact having also been noted by other observers. Harnack confirmed the excretion of the metal into the bile by feeding a peptonate of manganese to an individual with an operative biliary fistula and obtaining manganese in the bile collected. Von Jaksch (8) believed the foreign cases to have been due to lung absorption, the manganese being combined eventually as an albuminate and carried to the nervous system in this form.

Unfortunately, no autopsy records nor animal work have as yet given us any idea of the distribution of manganese in the body after steady ingestion of a salt over a long period of time. In such an industrial operation as the one we have described, great importance in regard to prevention is generally laid on eating in dust-free environment. Hamilton (17) has recently re-emphasized the absurdity of very much emphasis on this contention in regard to lead. The poison is swallowed chiefly during the many hours the men work in the dust and is perhaps coughed up and swallowed after leaving the mill. An insignificant minimum is taken in with the noonday lunch, and elaborate lunch rooms, etc., though desirable features of a dusty mill, nevertheless will not greatly affect the incidence of poisoning as long as work in a dusty atmosphere is required.

Casamajor (10) comments on the possibility of a toxic effect from the extremely strong magnetic fields in which many of his patients worked. The facts that three pronounced cases in this plant have occurred in men who have never worked in the neighborhood of the magnetic separators; that the French and German cases are identical in character and have developed under the influence of manganese alone, and, finally, that careful animal experimentation, carried out by one of us, in so far as it has gone, fails to show the least effect from extremely powerful magnetic fields (at least four times more powerful than have been heretofore utilized in experimental work,—all these considerations combine to remove the magnets as final causes of the disease. Whether they may be a contributing cause is another matter. It has been suggested to us that the lungs of the worker in manganese dust when moved into a strong magnetic field may experience actual penetration of manganese-bearing particles, and that such particles, being embedded in lung tissue, will be more readily transferred to the circulation. This seems, perhaps, an improbable assumption, but it is fortunately susceptible of experimental attack and can thus be cleared up in the near future.

PATHOLOGY

The symptoms of chronic manganese poisoning are strikingly definite. Once seen, the condition will not be confused with any other clinical entity. The implication of a clear-cut attack upon some one portion of the neuromuscular apparatus is, of course, conveyed by a syndrome of such fixed type. There are no post-mortem data on any of the foreign cases: the disease itself has never been fatal either in Europe or in this country. Casamajor (18), however, has reported a single autopsy upon an advanced case of manganese poisoning, the patient dying of pneumonia. His description may be summarized as follows:

Gross observation showed no changes in the brain, kidneys, liver, nor spleen. Microscopical observation showed the following changes:

Kidneys.—A moderate chronic interstitial nephritis was present.

Liver.—There was considerable biliary cirrhosis and the liver cells contained much pigment, the majority of the granules being iron-containing.

Brain.—"There was some degeneration of more or less regular character in the longitudinal fibers in the pons which run

with those of the pyramidal tracts. While these degenerations are regular enough to be assembled into clearly defined tracts, nevertheless, it was not possible to determine exactly either the upper or lower level of the tracts in question. The degenerated portion does not appear to go above the upper level of the pons, nor does the lower portion extend to any appreciable extent into the medulla. . . . The pyramidal tract elements are clearly defined, and those of the fronto-pontine and temporo-pontine tracts are fairly so."

In our present state of knowledge these findings do not lead to any conclusions whatever. Stöcker (19), in describing a case of progressive lenticular degeneration, mentions the fact that one must always be certain, in making a diagnosis of this disease, that the patient has not worked in manganese, since the symptoms of chronic manganese poisoning and those of this rare nervous disease are strikingly similar. It is unfortunate that we have no record in Casamajor's (18) autopsy of a definite examination of the lenticular nucleus. While gross changes, such as were found in Wilson's (20) instances of lenticular degeneration, could not be expected except in the most extreme grades of manganese poisoning, grades never found clinically, it is possible that microscopical degenerations may have existed. The syndrome presented by Wilson under the title, "Progressive Lenticular Degeneration: A Familiar Nervous Disease Associated with Cirrhosis of the Liver," has marked similarity to paralysis agitans, and indeed such cases have been called juvenile paralysis agitans (19). Wilson, while not the first to describe the condition, has given the first thorough account of lenticular degeneration and his paper contains much material of interest in relation to manganese poisoning. In mentioning this similarity it should be noted that Wilson's very careful microscopical examinations contain no mention of the lesions in the pons described by Casamajor (18) (cf. p. 187). If these lesions represent the pathology of manganese poisoning, which Casamajor does not claim, there is no known pathological similarity to lenticular degeneration. Future observation may clarify the whole question.* Animal experimentation in the hands of both von Jaksch (8) and Casamajor has proved entirely ineffectual in reaching the true pathology. Possibly more intensive experiments may bring success.

COURSE OF THE DISEASE

This is best given through the media of clinical histories of several of our own cases.

Report of Cases

Case 1. *History.*—An American mill hand, single, aged 30, with negative family history and previous personal history, was first seen on June 19, 1918. He complained at this time of finding it "hard to walk." The patient first became a mill hand in 1904, and was employed in dusty work as a brusher on the screens. He had no cough while so employed and noticed no symptoms until a year and a half later. During this period he was shifted about upon various jobs in the mill. His first symptoms consisted in a "twitching" of the fingers and legs. If he stood all day he had a bad night on account of hard cramps in the legs; otherwise he had a pronounced tendency to sleep. It is still true that fatigue produces twitching and cramps so that the patient never walks far. After the onset of symptoms, the patient stopped work for a year and then came back in a dust-free job. In 1908, being apparently in good condition, he again worked as a screen man for seven months, when poisoning again became noticeable, and he was given light work. On Nov. 29, 1913, he was pensioned.

There is a vague history of constipation and indigestion while at work in the dust but no record of cough. He remembers clearly that nocturia once or twice was the rule while working but this has now stopped. Periods of uncontrollable laughing and crying have been present since early in his history. He cannot give the date of onset of these symptoms. Cramps in the legs were marked and rather incessant in 1913, but have improved so that they do not occur now unless he has had a very active day. The patient's hands no longer twitch unless he is very tired, and his legs are subject to the same rule but are less easily controlled than his hands.

Physical Examination.—The patient, a slender man, stands with his feet slightly apart and in this position does not sway. His memory is good and he gives an account of his positions and work since 1904 which checks perfectly with the mill report. His replies are somewhat hesitant but he is positive about assertions once made. His reputation is that of being mentally subnormal, possibly because of his slowness of speech and his constant foolish smile. This foolish smile is present most of the time, but the patient has no difficulty in controlling it when questioned and required to answer. His face is without wrinkles and displays the smooth fixation so characteristic of the disease. The pupils are equal and regular and react quickly to light and accommo-

*Readers interested in the clinical similarity between chronic manganese poisoning and progressive lenticular degeneration are referred to an article on "The Clinical Aspects of Chronic Manganese Poisoning," D. L. Edsall and C. K. Drinker, Osler Anniversary Volume, 1919.

dation: the sclerae are clear: there is no lacrimation, no lid-lag, no exophthalmos nor muscular palsies; the form fields are not restricted; slight, but easily elicited, nystagmus* is present. The fundi have not been examined.

The patient's voice is clear but his speech is slow, though there is no slurring nor difficulty in forming words. He makes rather frequent large swallowing movements of which he is apparently unconscious.

Examination of the lungs, heart and vessels shows nothing abnormal. The heart rate is 76 and the blood pressure normal. Abdominal examination shows nothing unusual with the exception of hyperactive reflexes.

Examination of the extremities shows a fine tremor of the outstretched hands and, in addition, frequent periods of tremulous movements more like the pill-rolling tremor of paralysis agitans than anything else. Biceps, triceps, and radial periosteal reflexes are equal on the two sides and slightly exaggerated. Examination of the legs shows no muscular wasting, paralysis, tenderness, nor edema, and no fine tremors. There are rather infrequent periods of rapid movements of the heels by the calf muscles. These spells of "teetering" are not accompanied by pain or cramp. Patellar and Achilles tendon reflexes are exaggerated and equal on the two sides. There is slight ankle clonus, no patellar clonus. The Babinski reaction is absent. The patient cannot stand with feet close together but falls in any direction when so placed. He presents the characteristic slapping gait of the disease and walks successfully with his eyes closed. Retropulsion is marked and propulsion is easily brought out when the patient stands on his toes. There is no intention tremor and no incoordination in finger to finger and finger to nose tests. There is slight resistance to passive movements. There are no disturbances of sensation of any sort.

Laboratory Findings.—Routine blood and urinary examinations gave entirely normal results.

Summary.—A boy was employed in dusty work for one and one-half years and was then compelled to cease work on account of twitching of the fingers and legs and on account of cramps in the calves. About three years later, being apparently well, he again worked in heavy dust, and after seven months noticed a tendency to fall and felt weak and tired. Being removed to dust-free surroundings, he did not recover but showed uncontrollable laughter and crying, cramps in the legs, and a certain amount of muscular twitching. On physical examination he displays no prominent mental deficiency. His face is smooth and constantly smiling. Speech is very slow. There is a fine tremor with periods of "pill-rolling" in the hands. The legs display tremor and twitching. All tendon reflexes are somewhat increased. Ankle clonus is present, likewise retropulsion and propulsion. There is no evidence of any sensory disturbance.

CASE 2. *History.*—An American mill hand, aged 47 years, with negative family history and previous personal history, was first seen on June 22, 1918. His complaint was that he "walks bad." The patient came to work as a mill hand in October, 1909. He was first employed as a cleaner. After three months as a cleaner, he became a machine tender, and continued in this employment for about ten months. One month after being employed, he noticed persistent cough, and two months later that his legs "seemed to be stiff." After three or four months both arms and legs began to twitch. He has never had cramps in the calves nor in any muscles. He falls frequently both backward and forward, and it was on account of falling that he finally gave up work in 1910.

The most conspicuous feature of the disease in this patient has been the extensive muscular twitching. His left leg is in a constant "teetering" motion during the taking of the history, and his right leg falls into the same condition occasionally. There is a gross twitching of the hands, sometimes of the fingers and sometimes of the hands upon the wrists, which is absolutely continuous and which has not changed in any degree since 1910. The patient has never noticed any intensification of his twitching from fatigue. The patient's memory is unimpaired, and his general mental reactions accurate but very slow. Cough has disappeared since leaving dusty work, as has also a slight tendency to frequency in urination evidenced by nocturia twice nightly while in dusty work.

Physical Examination.—The patient is a large, well-built man with a stolid, ironed-out face and stands with feet wide apart and without swaying. This patient has never had any emotional lability during his entire experience with the disease.

Examination of the eyes shows a large corneal scar in the right eye. The left pupil is regular and reacts normally to light and accommodation. There is no nystagmus nor contraction of form fields. His teeth consist of old snags only and there is very bad pyorrhea but no pigmentation. The voice is low and there is no slurring nor stuttering in speech. The tongue, tonsils and pharynx are normal. Words come very slowly and are used with a curious economy.

Examination of the neck, thorax, lungs, heart, and vessels shows nothing abnormal. The blood pressure is normal. Examination of the abdomen shows no tenderness nor palpable masses. The abdominal reflexes are exaggerated.

Constant tremulous movements of all muscles of the arms are conspicuous. These never stop entirely but groups of fibers in different parts of the muscles fall in and out of activity. This is particularly noticeable in the pectorals, which, however, never contract vigorously enough to move the arms. The forearm muscles have enough coordinate activity to cause a constant coarse tremor of the outstretched fingers and frequent movements of the hands on the wrists. Biceps and triceps reflexes are present, equal on the two sides and somewhat exaggerated. Radial periosteal reflexes cannot be obtained. No muscular atrophy, tenderness, nor abnormal weakness.

*This is the single case in which we have seen nystagmus. It was so slight in this instance that we take it to have been accidental and of no importance.

There is constant twitching in all the muscles of the legs, particularly evident in the gastrocnemei and best seen in them when the patient stands supported on his toes. He is unable to stand with feet together unsupported, and falls backward at once. There is no increase in tendency to fall with the eyes shut. The gait is very characteristic and well carried out with eyes closed. Shoes are worn equally over the entire sole. This is characteristic of all these patients, and emphasizes the necessity of placing the whole foot on the ground at once, thus keeping as wide a base as possible. (The patients we have seen do not tend to walk upon the region of the metatarso-phalangeal joint as emphasized by von Jaksch.) Retropulsion and propulsion are marked. Achilles and patellar reflexes are present, equal, and much exaggerated. There is marked ankle and patellar clonus. Stretching of muscles in any part produces rhythmic muscular contractions. Thus, frequent tapping of the biceps muscle throws the muscle into clonus, which is maintained for some time. There is no incoordination in finger to finger and finger to nose tests, though the hands shake violently when brought together to the nose. Tremors are not increased by intention. There are no abnormalities of sensation of any sort.

Laboratory Findings.—Routine blood and urinary examinations gave entirely normal results.

Summary.—A man of forty-seven, after four months' employment in dusty surroundings, noticed stiffness of his legs, and three months later both arms and legs began to twitch. His total exposure to manganese dust was thirteen months. He exhibits, at the present time twitching, retropulsion and propulsion as his most conspicuous symptoms. On physical examination his face has characteristic smoothness. Increase in reflexes and clonus are very pronounced. He is altogether without sensory symptoms.

CASE 3. *History.*—An American workman, aged 38, with negative family and past medical history, was first seen June 22, 1918. His complaint was, "My legs—I can't feel good." This patient was married in 1906, and at the time of examination had one healthy child seven years old. The patient regards himself as normal sexually and his wife is quite well. (There has been no evidence of any sort of sexual abnormality in connection with manganese poisoning. Several patients have had children born since they were placed upon the pension roll of the company.) This patient has been known as a case of manganese poisoning since August, 1916.

He first went to work in the mill November, 1915, as a cleaner. This was a very dusty occupation and he continued in it until June, 1916, when he became an oiler on the motors, and in this capacity worked all over the plant, and was consequently in dust of varying concentrations. Shortly after taking this new work, he thought he had malaria, as he felt sleepy and out-of-sorts all the time. He, himself, noticed nothing the matter with his legs until his friends told him he was not lifting his feet up when he walked. He did not know that he could not walk backward until examined by the company physician in August, 1916. There were no cramps and no muscular twitching at this time. On August 31, 1916, he was shifted to dust-free work, as it had become evident that he was a definite case of manganese poisoning. During the next two years his walking gradually grew worse, but he did not experience cramps in the legs until just before leaving work entirely in April, 1918.

At present, he can work in the garden for about half a day and then his legs get "achey and weak so that he has to quit." After as much work as this the muscles in his calves "knot up", and he has noticed that this tendency to cramp is always distinctly worse after fatigue. He has never had much twitching, but occasionally it is noticeable in his legs when sitting down, and these periods always come when he is fatigued. Reading tires him. Writing is difficult, apparently because he has a distaste for attempting any muscular movements. (A similar distaste has existed in other cases and seems related to the concentration which goes with every use of muscles. The muscles are forced to perform work, and this forcing results in no appreciable gain in smoothness of action.) The patient has never shown any tendency to laugh or cry. His wife, ever since 1916, has noticed a tendency to sleepiness and detachment.

He walks forward very successfully and does not notice propulsion unless going down hill. Any influence, such as walking down a steep incline, which interferes with the protection which his gait offers him against propulsion, brings propulsion out. Recently, for instance, he lifted a box and started to walk forward. This weight brought him up on his toes and he at once commenced to run and finally fell. The patient rides a bicycle, but must have help to get on, and always ends his ride by falling off.

Cough came on after working a short time in the dust, and this was accompanied by profuse dusty expectoration. He has no cough at present and has not noticed that cough is a general complaint of men so employed. During the entire history taking the patient exhibited no twitching whatsoever.

Physical Examination.—The patient stands normally and shows no loss of flesh. He is mentally alert and interested in the examination. His face is very smooth and expressionless, this feature of the disease being extremely marked. His pupils are equal and react normally to light and accommodation. There is no nystagmus nor paralysis of the external ocular muscles and the form fields are not restricted. The fundi were not examined.

The tongue is protruded in the middle line and shows a slight fine tremor. There is no abnormality of the voice or of enunciation.

Examination of the thorax and lungs shows nothing. The heart is not enlarged. Occasional extra systoles are heard which are apparently ventricular in type. There is no sclerosis of the vessels and the blood pressure is not elevated. The abdomen and genitalia are normal.

There is no wasting nor paralysis and no tremors of the extremities. Occasional coarse twitching of the arms and forearms occurs. Biceps, triceps, and radial periosteal reflexes are

present, equal, and exaggerated. Clonic movements of the muscles cannot be elicited. Finger to finger and finger to nose tests are well performed. There is no wasting, twitching, nor tremors of the legs. Patellar and Achilles reflexes are present, equal and exaggerated. No ankle nor patellar clonus can be brought out. The patient cannot stand with feet together in this position—he falls backward. This is no worse with eyes shut. The patient's gait is characteristic. The legs are kept rather far apart, the feet lifted very slowly and slapped rather evenly on the floor, the shoes being worn equally on all parts of the sole, as is characteristic of all patients who show the gait well. Propulsion and retropulsion are easily brought out. Sensation is normal.

Laboratory Findings.—Routine blood examination disclosed nothing abnormal. The urine was not examined.

Summary.—A man of thirty-eight, after seven months of dusty work noticed sleepiness and general malaise. After nearly a year's time retropulsion was discovered. His gait became gradually worse and eventually cramps in the legs became troublesome. At present he is easily fatigued and has a distaste for attempting finely coordinated movements. His face is very smooth. He presents tremors of the arm muscles and some increase in tendon reflexes both in arms and legs. He cannot stand with his feet together. Retropulsion and propulsion are marked and there is the characteristic protective, slapping gait.

As we have seen chronic manganese poisoning the following findings make the syndrome. We have numbered them in the most common order of appearance. It is difficult to emphasize in any written description the clearness with which the symptoms come out and the ease with which the diagnosis can be made.

1. A history of work in manganese dust for at least three months.
2. Langour and sleepiness.
3. Stolid, mask-like facies.
4. Low monotonous voice. Economical speech.
5. Muscular twitching, varying in degree from a fine tremor of the hands to gross rhythmical movements of the arms, legs, trunk and head.
6. Cramps in the calves and a complaint of stiffness in the muscles of the legs, the cramps usually coming on at night and being worse after a day of exertion.
7. Slight increase in tendon reflexes.
8. Ankle and patellar clonus. Frequently by stretching any of the muscles of the body it is possible to elicit rhythmical contractions. Romberg sign is inconstant: there is no incoordination.
9. Retropulsion and propulsion.
10. A peculiar slapping gait. The patient keeps as broad a base as possible, endeavoring involuntarily to avoid propulsion. The shoes are worn evenly and we have not been able to convince ourselves of the pronounced tendency to walk on the region of the metatarso-phalangeal joints, a feature strongly emphasized by von Jaksch (8).
11. Occasionally, uncontrollable laughter; less frequently crying.
12. Uniformly absent are any disturbances of deep or superficial sensation, eye changes, rectal, genito-urinary or gastro-intestinal disturbances, reactions of degeneration, blood, urine, and spinal fluid alterations. It is significant that, unlike lead, manganese produces no life-shortening degenerations. Seriously poisoned men are long-lived cripples. The metal apparently makes a very definite attack upon some non-vital portion of the neuro-muscular system, destroys it thoroughly, if time for action is permitted, and leaves the victim quite well in every other respect.

We have never seen either the salivation or edema described in foreign cases.

TREATMENT

After the harm has been done there is no form of treatment which has any value. Early cases recover spontaneously, if placed in dust-free environment. The problem therefore becomes one of prevention alone.

PREVENTION

Wagener (3) and Friedel (5) have given summaries of this phase of the subject, but their directions are not based upon observations on enough cases to lay down thorough directions.

It is clear that dust removal will destroy the possibility of disease incidence. The extent to which this must be accomplished cannot be given exactly. Apparently some of the German cases working in a dust of practically pure manganese dioxide have been more severe than any, with one possible exception, seen in this country. If the metallic concentration in the dust breathed is high, removal must be proportionately more complete. In this regard it is interesting to note that we have never seen a case of manganese poisoning develop as a result of work in a very thick

dust averaging 5 to 6 per cent. of manganese, while in the same neighborhood the cases we have described have come from a mill, also thick in dust, with a manganese concentration of 9 to 12 per cent. This latter concentration seems to be just able to poison if present in air thoroughly laden with dust. Manganese is apparently only slightly toxic and susceptible individuals are few. As a consequence it is probable that poisoning can be controlled in processes where total dust elimination is difficult, if the elimination is at least partially successful. Where, however, any possibility of poisoning exists, special measures as to physical examination of employees should be taken. We have said that the shortest period of exposure resulting in permanent disability of which we have knowledge is four months and five days. We have seen the development of very clean-cut symptoms in one month and fifteen days. Couper (1) had recovery in three cases showing minor symptoms—the character of which he does not give—on removal from dusty work. Our experience corroborates this. The disease must advance to a considerable degree to be dangerous, but in this regard caution is necessary since each man after several months' dusty work possesses a reservoir of dust in his lungs which is absorbed directly and also coughed up and swallowed. Consequently, on appearance of symptoms, it is essential that removal from dusty surroundings be accomplished at once, leaving the patient nothing to contend with save the dust already swallowed. Our examination of the problem has caused us to institute quarterly physical examinations for men working in dusty parts of the mill which has produced our cases. These are recorded upon cards of the following type:

EXAMINATION CARD

Name..... Nationality.....

Date and Age First Employment..... Pay Roll No.

DATE AGE

KIND OF WORK		Weight	History of Sleepiness, Weakness or Cramp	REFLEXES		CLONUS		Tremor or Twitching	Propulsion, Retropulsion and Gait	General Remarks Speech Cough Facies Salivation	Employment Record
Date	Work			Biceps	Knee Jerk	Ankle	Patellar				

Such examinations can be made extremely rapidly and have worked well. Early cases are detected readily, and changed to dust-free jobs before harm is done.

As in the case of lead poisoning, ma-

lingering and even a definite manganophobia occur. Unlike lead, manganese is clean-cut in its attack and while such instances must make occasional trouble they can never escape eventual detection.

In conclusion, it is the urgent hope of the authors that industrial physicians having opportunities to observe men handling manganese compounds will be on the alert for poisoning and will see that their observations reach the literature upon the subject.

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PUBLIC HEALTH NURSING AND INDUSTRIAL HYGIENE*

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IT has been said repeatedly that nursing is the right arm of the medical profession. Certainly it is true that public health nursing is the right arm of preventive medicine, for upon the successful administration of public health nursing the actual accomplishment of many of the plans conceived by the public health officer or the industrial practitioner must depend. This is because we must look to the enlightenment and persuasion of the public and not to the aribitrary enforcement of a law for any permanent improvement in public health.

For the last thirty years and more there has been in this country a body of community health visitors known as district nurses or as visiting nurses. In most of our large cities there is an unofficial health association, known as the "Visiting Nurse Association" or the "District Nursing Association,"the purpose of which is to shape the policies governing this form of health work and to raise the budget necessary to maintain it. In 1918, the Chicago Visiting Nurse Association spent $165,461.25; the Boston Instructive District Nursing Association, $129,114.93; and the Philadelphia Visiting Nurse Society, $78,-317.64. The health work undertaken by these various associations differs more or less with the differing opinions of the board of directors in one or another city. In many small towns and in many country places the people have come to believe that a visiting nurse is a necessity to the community. One of the oldest of these associations is the Instructive District Nursing Association of Boston. Its act of incorporation plainly states its purpose "to give nursing care to the sick poor" of Boston. Such expressions as this are to be found in the early reports of most of the large visiting nurse associations. They show, first, that the origin of such work was frankly a "charity"; and, second, that the preventive work, which was done by the nurses in the early days of visiting nurse associations, was only such as came incidentally to the bedside nurse, who "instructed in the laws of wholesome living" while she made a bed, gave a bath, and carried out a doctor's orders. This early phase of public health nursing laid a valuable foundation for the work of to-day, in creating a welcome and an understanding in the neighborhoods where the nurses worked. This friendly feeling toward the nurse was a valuable asset to the modern movement, but it has taken some time and will take longer still to efface the impression created in the community, that all visiting nurses are charity workers, and, as such, not acceptable to an independent public, even though they are desirable for those neighbors (constituting 50 per cent of a city community), who are unable to pay for medical care, preventive or otherwise.

When, in the year 1893, the Henry Street nurses began their work in New York City, an important step in the progress of public health nursing was taken by encouraging the payment of a small fee for each visit, and so emphasizing the public service rather than the charity aspect of visiting nursing.

A community service for which anyone may pay becomes very popular when it is a service which may be needed at any time by any family in the neighborhood. There have been remarkable results due to the home nursing performed in this way under the direction of visiting nurses. The technical nursing, performed by the nurse herself, during her short stay in the home, is of comparatively little value because after her visit nursing care may be entirely suspended until she comes again. Of much more consequence to the family is the ability of the visiting nurse to teach the elements of home nursing to some member of it. This teaching is capable of producing good results in recoveries from illness and in prevention of the spread of disease. It has been a matter for later experience to see the infinitely greater value of so educating visiting nurses and organizing their work that they will undertake the systematic health teaching

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which means prevention of the occurrence of disease, the correction of remediable defects, and the avoidance of that underweight and undernourished condition so often observable in family visiting. In a more or less desultory manner, health teaching or preventive nursing accompanied the demonstrations by means of which home nursing was taught. Many visiting nurses, in the early days, taught prenatal care and undoubtedly did much valuable preventive work, but until about 1900 there was no organized attempt to bring the laws of preventive medicine directly into homes and schools and industrial plants through the agency of the visiting nurse. Dr. Mock, in his interesting article in the May issue of THE JOURNAL OF INDUSTRIAL HYGIENE, in which he traces the development of industrial medicine and surgery, makes no mention of the industrial nurse and yet in all these important ten years during which industrial medicine and surgery have been so rapidly developing, the industrial nurse has been present in many plants and has been an active influence in fostering within the walls of the factory, that interest in public health without which there can be no permanent improvement in health conditions. If public health nurses are indeed the "right arm" of preventive medicine should they not be given due recognition?

Four years ago, nearly half the ten years during which we have seen the rise of industrial medicine, the Boston Association for the Relief and Control of Tuberculosis created a small sub-committee on health in industry. An executive secretary was engaged, whose chief function it was to persuade various employers of labor of the value of industrial nurses. The secretary, Mrs. Anna M. Staebler, is still occupying this position. She herself is a graduate nurse who has had special preparation for public health nursing. The efforts of this committee have been successful in establishing many industrial nurses in plants where, up to the time of their employment, no health work had been attempted. Of course there is the danger, when a factory begins health work with a public health nurse, that the management will believe it has done all that can reasonably be expected to guard the health of its people. The greatest safeguard against this danger will lie in the nurse herself whose knowledge of current developments in industrial medicine and whose enthusiasm for better health facilities for her people should enable her to help greatly to secure them.

About the year 1905, the leaders of the anti-tuberculosis movement began consciously to realize the need for homely visits made systematically for the purpose of teaching, by means of demonstrations, the way to prevent the spread of tuberculosis; to hunt up exposed persons (not always an easy task) and to persuade them to have a physical examination; and at the same time to induce those patients remaining at home to follow the directions given them by the doctor.

In 1909, the first meeting of the American Association for the Study and Prevention of Infant Mortality was held. The formation of this association, with the spread of educational propaganda resulting from it, greatly increased the demand for visiting nurses to go into homes for the purpose of teaching, by practical demonstration, those simple facts about the care of babies so essential to their health.

In 1902, school nursing was established first in New York City, and soon afterward very generally throughout the country. In this branch of visiting nursing also, the nurses' most important function is to teach through demonstration, in order that those defects discovered in the schools, through inspection, may be remedied. All these newly organized teaching bodies found their practice ground in the home. Graduates of schools of nursing were selected to do this work because there is in the hospital course a certain background of training valuable for a public health nurse to possess. Neither in 1900 nor in 1919, however, has the education of a nurse been of a kind to fit her to become a successful public health teacher and visitor. Many public health nurses, like the writer of this article, can testify to this out of their own experience of having struggled into this new profession of public health nursing with no preparation other than that afforded by a hospital training school.

The subject of proper preparation for public health nursing is too large for this paper. It is, however, of vital interest

and importance to all who are engaged in public health administration.

The consequence of rapidly filling the demand for school nurses, tuberculosis nurses, and well-baby nurses from among the ranks of graduate nurses, with no experience or special training, was just what might be expected. The newly recruited workers were severely and sometimes justly criticized because they had such an inadequate knowledge of social conditions, of the principles governing social work or the agencies established to carry it on, because they were ignorant of what constitutes a properly balanced diet and of how to adapt it to age-old customs brought here from other countries; because they knew nothing of applied bacteriology, or of social legislation; and, more than everything else, because they had had no practical experience in visiting in homes and so learning how public health teaching may be done. Public health nursing has, through a great many difficulties and a great deal of criticism, come to a place of some importance in community health work. Upon the number of public health nurses in a community and more particularly upon the quality of work which they do, must depend chiefly the lowering of the mortality rate of that place and the reduction of its morbidity.

Community Nursing

The public health or community nurse of to-day is concerned chiefly with the family and not chiefly with the individual. She is much more interested in preventive teaching than in any other function which she may perform in the homes to which she goes. She is engaged in what Florence Nightingale described as "well-nursing" in contrast to sick-nursing, although she must, if she is to be an effective teacher of home nursing, frequently demonstrate the technique of bedside nursing. She may belong to any one of the following groups of nurses:

1. Anti-Tuberculosis — Administered by Board of Health or Private Society.
2. Child Welfare — Administered by Board of Health or Private Society.
3. School—Board of Education.
4. District or Visiting—Private Society.
5. Industrial.
6. Board of Health.

Varied as are these administrators of public health nursing and wasteful as is the present un-relation of one to another, there is a certain natural division of their work. Four of the six spend the greater part of their time in homes and the other two spend the greater part of theirs in the working environment from which adults and children will return to these homes; that is, in the schools and in the industries. A nurse from one group plays into the hand of a nurse from another.

The Present Moment in Public Health Nursing

We have passed out of the period of experiment and have come to some conclusions which leave no room for doubt. Many studies and surveys have been made in the last five years and the deductions drawn from them show that public health nurses can and do reduce mortality definitely and immediately when certain definite functions are performed by them. Fifty per cent. of infant lives are saved by prenatal nursing; maternal mortality is tremendously reduced when nurses are available for postpartum care also. In the schools the improvement in the percentage of regular attendance since school nursing was introduced shows how successful this work has been.

Many industrial managers who have health nurses as a part of their establishment will testify that it pays. Public health nursing administrators are now looking toward a step which will bring these improved health conditions into every family, every neighborhood, every school and every industry. The time has come when we can no longer content ourselves with the casual, haphazard methods of the past. The scattered trades such as the work of longshoremen, tailors, painters, carpenters are not as yet affected in any very intimate way by organized health work. There is a plan of neighborhood organization, described later under Community Health Center, that will make these health facilities, health clinics and health nurses, readily available to everyone.

We have been considering the subject of public health from the standpoint of some one of the specialties, or of an experiment. We are now on the eve of making our point of departure the unit

of population. The public is ready for this health unit idea as it never has been before. The revelations made by the physical examinations for the draft have brought home to many people the value of positive good health—health that means sound teeth, unbroken arches, unimpaired vision. Young men who have been in the service are coming back to their homes all over the country, having had the satisfaction of experiencing such a state of health for the first time in their lives. They value it and will want it for their children.

Another influence that has been at work to produce this moment of opportunity in public health nursing is the educational campaign which has been the result of "Children's Year," the work of the Children's Bureau and the Women's Council of Defence. To anyone who has not been closely connected with this work it is astonishing to follow the results of the past year and a half. Women of all degrees of education are for the first time fully aware of the loss of life among the babies in their particular town, of the reasons for this loss, and of the means necessary to prevent it. In this connection it is worth while to review the work of one state during the past two years. The Massachusetts State Department of Health formed a committee on child conservation in the very early days of our participation in the war. The committee was an advisory committee having power to act. The Massachusetts Women's Council of Defence with its sub-committee on child welfare became an integral part of the state committee. This was accomplished by including both chairman and vice-chairman of the Women's Committee in the Advisory Committee of the state Department of Health. The American Red Cross provided money for the immediate needs of the committee over and above what the state Department of Health could appropriate. This expense consisted of salaries and traveling expenses for the eight specially trained and experienced public health nurses who were immediately engaged to act as child welfare supervisors for the state. More than $70,000 was appropriated or given in various localities throughout the state for the work of child conservation, through the combined interests represented in this movement. Better than anything else has been the permanent and genuine interest in health aroused in towns and cities and rural communities, where before this time there had been very little.

The public health campaign of the Red Cross is a great force for the education of the people and has already greatly increased the overwhelming demand for specially trained public health nurses.

Nurses in Industry

The work of nurses in industry is almost entirely unstandardized. Some individual nurses have been able to develop excellent systems of public health nursing work in the industries to which they have been attached. Where industrial medicine and surgery have already been established in a plant, industrial nurses readily become a part of the general health plan. However, in many instances, during the past ten years, the industrial nurse has been the only health agent employed by the management. It is obvious enough that where minor accidents occur in an industry a graduate nurse is of value to give first-aid treatments. This, of course, is the smallest part of a nurse's work in a factory. Indeed, a good industrial nurse expects to see these minor accidents grow fewer as her influence in the factory grows. She does not encourage treatments, and deplores the necessity for them since it means that good preventive work has not been done. There is a type of visit to her office which the nurse encourages because it gives her an opportunity to advise while there is still time to prevent some impending ill. When a girl's confidence has been won it is easy to persuade her to have dentistry done, eyes examined, or even to change her manner of dress or her choice of food. It is the result of these friendly interviews that seems of most value to the management.

One successful industrial nurse described an important part of her work as "factory housekeeping", and certainly such housekeeping is much better done in plants where there is a good industrial nurse. Her presence alone suggests to forewomen and foremen that the sanitation of that part of the plant under their control is a matter of importance to the manage-

ment. Home visits are often made by industrial nurses. The visits are made for the purpose of looking up absentees, to see that there is proper medical care, and sometimes to help unravel a delicate social problem. The greater part of an industrial nurse's time is needed in the plant, and the better she is able to co-ordinate her work with that of the other public health nurses in the town, if there are any, the freer she will be for that purpose. Industrial nurses seem almost always to be welcome to the employees, perhaps partly because they are women and themselves employees, friendly and frank both with the workers and with the management.

In one large factory a girl had acquired a habit of fainting. Each time it happened all her colleagues in the great room where she worked stopped work and crowded about her in pity and curiosity. A considerable sum of money was lost to the firm in this way because, not only was work delayed, but the warm chocolate with which the girls were making *bon bons* was spoiled by being left and became a source of loss. After observing this once or twice the nurse sent for the girl wh fainted. She told her what it meant to the company to have the work stopped in this way, and told her that she was quite sure the tendency to faint could be controlled; finally, she told her that she could not continue to work at that business unless she did control it. Some weeks later this girl came to the nurse to say that this way of thinking about her ill-health had surprised her so much that she had never since that day been in the least inclined to faint, "even at home."

In a few words, we may say of the industrial nurse that among other things she acts as housekeeper and sanitary inspector, that she stimulates an interest in health, and that, being always on the spot, she is always accessible, although she discourages dependence upon her technical skill as a nurse; that she is proud when she can reduce the number of absences from work on account of ill-health by means of her teaching. She is a good interpreter of workmen to the employer and of the employer to the workmen. She is in a position to encourage and foster *esprit du corps*.

Co-ordination of Public Health Nursing in a Health Center

Mr. Michael M. Davis and Dr. Andrew W. Warner in their book on *Dispensaries* (The Macmillan Company, 1918) have given an admirably clear picture of the Health Center as it has been developed in this country.

In this book we read that because progress in the various public health movements has been so rapid each one of these movements must now consider not only the "pleasure of growth," but the "problem of co-ordination."

Certainly it is true of public health nursing. Heretofore, community health workers have begun in a neighborhood because each worker has been particularly interested in some specialty; in a disease, in young children, in industrial plants, in the public schools or in an effort to relieve the suffering caused by illness. Public health nurses have flocked to meet the enthusiasm of these special interests which become so absorbing that, to an outside observer of the neighborhood, these interests come to seem like so many "fads."

The conscious attempt to co-ordinate public health nursing interests and activities leads first to a common building where all the office work of all the neighborhood nurses is done. Mr. Davis and Dr. Warner (pages 318 and 319) describe a Health Center in the following outline:

1. A population unit, i.e.:
   - a. The area and population covered is defined.
   - b. The aim is to reach all the population so far as the health services offered apply.
   - c. The results are measured by the 100 per cent. test, that is, not the number of persons reached effectively, but the proportion of the population which is reached effectively.
2. The co-ordination of local effort, especially
   - a. Of the medical and sanitary services within the district.
   - b. Of the nursing services, involving correlation or combination of various nursing specialties.
   - c. Of social services, involving correlation or combination of neighborhood forces, and of the social agencies at work in the neighborhood.
   - d. The local headquarters and clinics of all forms of public health work for a district to be within a single building.
3. A local administrative unit, involving
   - a. A local administrative head.

b. Supervision of all special services by specialists working administratively through the local head.

Public health nurses working from such a neighborhood center would approach the needs of the community from a different starting point from that of the special interest. To begin with, the number of people in the area must be known, then the number of families, then the industries, the prevalence of sickness, the death rate by age—groups, nationalities, and also by sex, and finally the number of families for which each public health nurse could assume responsibility. Teaching home nursing by means of demonstrations of bedside care is a very great asset as a means of entry into a family and, for that reason alone, must be cherished as a valuable function by the community nurse who wishes to reach all her families.

Only about 47 per cent. of families in a city neighborhood are unable to pay anything for medical care. Many of the remaining 53 per cent. can pay the full cost of a nursing visit. It is not easy to enter these homes for the purpose of health teaching unless the entrance can be made by offering a service which the people want, and a good nurse is always welcome in a sick-room. The organization of a health center from which public health nursing is to be administered requires three distinct types of workers:

1. Health authority, represented by federal, state, county, or city health officers.
2. An active and representative committee of men and women living in the neighborhood.
3. Professional workers; that is, local doctors, specialists, such as oculists, dentists, pediatricians, obstetricians, and public health nurses.

It is difficult to say which of these essential groups is most important. There could be no success without all three. Upon the neighborhood committee rests the responsibility of voting policies and finding the budget; of developing local publicity through newspapers, moving picture houses, health bulletins, posters, public lectures, and through the numerous other ways each neighborhood will discover. The power of a local health committee like this cannot be overestimated. The responsibility of spending our own and our neighbor's money in such a way as to produce better health in our own community, and at the same time, better results than are being produced at an adjoining health center, is a force for the education of the committee and through the committee of the entire neighborhood.

This education in matters of public health through the responsibility of administration was one of the interesting effects of the Health Insurance Act in England. Early in 1915, the writer was in a little village in Devonshire. On asking how we could learn about the public health nursing going on there, we were referred to the local chemist. He was serving on the committee which administered the maternity benefits and his store of accurate knowledge about the service was as remarkable as was his enthusiasm and understanding of its value to the community.

When all is said, we must come back to the starting point of the suitable education of a public health nurse. Everything depends upon her ability to see her work from a high enough vantage ground to enable her to continue in it without too great discouragement, and also to enable her to keep her own enthusiastic belief in it vividly before the minds of her committee.

Supervision of special forms of public health nursing work by specialists is very necessary for the success of this form of organization. It is only when home nurses are responsible for the health of as many families as each can thoroughly supervise, and for not one more than that number, that we shall be able to observe the effect of co-ordinated public health nursing work. It is evident that home nurses greatly need the intimate knowledge of factory and school which the industrial nurse and the school nurse possess and it is equally evident that the family would profit greatly by a more intimate relation between all community nurses and by a plan of administration that puts into the hands of home nurses the knowledge gained by industrial and school nurses and *vice versa*.

Under such a plan, much of the home visiting now done by industrial and school nurses would be delegated to the nurse already familiar with the home, record keeping would be greatly simplified, edu-

cational propaganda would take a broader and more effective aspect, emphasizing the public health of the community rather than differing phases of the subject.

The question of financing public health work in the United States will not long remain unanswered. When Americans do decide in what way this bill shall be paid, the Community Health Center, with its local administrative committee, its connection with established health authority, and its organized groups of doctors and of public health nurses will be in an ideal position to administer the funds.

INDUSTRIAL POISONING BY COMPOUNDS OF THE AROMATIC SERIES*

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BENZENE

In the making of coke and by-products, coal is roasted and the lighter vapors, benzene, toluene and xylene, are absorbed in high boiling oils and subjected to fractional distillation. The danger from contact with benzene begins in the distilling house, and though in the ordinary working of a plant, there is no danger of industrial poisoning, any accident which results in a spill or which necessitates repair work, is attended with a great deal of danger. For instance, not long ago, a man was drawing off the water from the bottom of the benzene settling tanks. To do this he had to stoop down under the tanks. He was supposed to shut the stopcock as soon as benzene began to flow, but apparently he was not prompt enough, the fumes of benzene began to escape, he grew dazed, started to leave the place without turning off the flow, but collapsed on the floor where he was found some time later. Two men went to his rescue but in carrying him upstairs, one was overcome by the fumes and fell backward, breaking his neck. The workman himself was revived.

The lightest distillates are benzene, toluene and xylene; next come crude carbolic acid and naphthalene; then anthracene; and the residue is coal-tar pitch. The use of these different distillates is increasing very rapidly. While in 1914 they were expensive, being almost wholly imported from Germany, they are now manufactured on a large scale in this country and are rapidly displacing the less powerful solvents of the petroleum series. Benzene is used as a solvent for rubber in rubber manufacture and in making rubber cement. It is used in paint and varnish removers. It is present, together with the heavier bodies, in the coal-tar paint which is applied to water bottoms of ships and is used in painting bridges. Benzene is also the starting point for the ordinary method of making phenol and as a starting point for many of the aniline dyes and coal-tar medicines.

In benzene intoxication the brain and spinal cord contain relatively more of the poison than any other structures, probably because of the great solubility of benzene in fats and fat-like bodies, such as the lipoids of the nervous system. The effect on the blood is marked and characteristic. There is an anemia of the aplastic type and a great diminution of the white corpuscles. Capillary hemorrhages under the skin and mucous membranes are so common that the Germans call this form of poisoning *Blutfleckenkrankheit.*

Selling (1) carried on experiments in benzene intoxication in rabbits and succeeded in reducing the leucocytes almost to the vanishing point, yet without killing the animals. The diminution of red cells was slighter and less constant, averaging only about 16 per cent. as compared with a loss of 92 per cent. of white cells. This leucopenia is chiefly polymorphonuclear. He also found a profound destruction of the hemopoietic structures, especially the

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marrow, which was followed by regeneration. Fatty changes sometimes developed in the liver and kidneys; hemorrhages occurred into the lungs, pleurae and stomach.

Hektoen (2), noting that these experiments of Selling's showed a selective action of benzene on the tissues and cells that are concerned in the production of antibodies and in defense against infection, took up the question as to the effect of benzene injections on antibody formation and on the course of infections. He found, in rabbits injected with benzene, a reduction of lysins and precipitins, together with grave lesions in the marrow, leucopenia, and a reduction in the phagocytic power of the blood. He concluded that benzene may lower resistance to infection by reduction (a) of antibody production, (b) of the number of leucocytes, (c) of leucocytic activity.

Further experiments with benzene have been carried out by Rusk (3) of the University of California, who also found diminution of hemolysins and precipitins in rabbits injected with benzene and concluded that since in these rabbits the marrow and lymphatic system show the most serious damage from the benzene, it is these structures that are chiefly concerned in the production of artificial precipitins and hemolysins. Weiskotton, Schwartz and Steensland (4) have done a great deal of work in this field, most of which has a bearing on the use of benzene as a therapeutic agent. However, one point which is valuable to the student of industrial poisoning is the effect of benzene in lighting up a latent infectious process. Four rabbits developed evidences of active acute infections in the course of daily injections of benzene, and in at least two it was apparent that these infections had existed in latent form before the injections were begun. In these animals there was no polymorphonuclear leucopenia following the benzene, and the animals died at the height of their leucocytosis with lesions in the organs characteristic of toxemia.

At the 1917 meeting of the American Association of Pathologists and Bacteriologists, Weiskotton reported experiments in the production of benzene leucopenia in rabbits by means of benzene vapors.

The instances in industry of benzene poisoning show that when exposure is excessive the effect on the central nervous system comes on with great rapidity, and a few minutes inhalation may be fatal. If the exposure is less great, there is time for an effect on the bone marrow and then multiple hemorrhages develop and the characteristic changes in the blood. I have records of men who were repairing pipes in benzene tanks or who were stopping leaks from benzene stills or simply watching defective benzene pumps, who succumbed so quickly to the effect of what did not seem to onlookers an excessive amount of the benzene, as to be fatally poisoned before help could come to them. One of these men was made to put on the usual Draeger helmet before he entered the tank. This helmet is so constructed as to prevent nose breathing by pinching the nose shut, the air that goes to the mouth being supplied by the pipe attached to the helmet. In spite of this protection the man fainted and when he was finally removed from the tank he was moribund. The only explanation the management could give was that the helmet had not entirely prevented him from breathing through his nose.

The susceptibility to benzene poisoning varies very much. In a coke by-products plant there was an overflow of benzene; two men who were working in the room fainted and fell to the floor, two others who went in to rescue them were likewise overcome and so were two more. After the six men had been laid out, there was a panic among the other workmen, but finally an Italian offered to go in saying that he never minded the fumes. He did go in, not even protected by a helmet and carried out the six, one by one, remaining apparently quite unaffected by his exposure.

The slower and more characteristic form of benzene poisoning with changes in the elements of the blood and with multiple hemorrhages was first described in this country by Selling (5) of Baltimore. His cases were young girls, fourteen years old, who had worked in a cannery where a solution of rubber in benzene was used to seal cans. Selling describes three cases, all with purpura hemorrhagica. The first of these, a girl of fourteen, had been at work for four months. She was brought to the hospital in a toxic stupor with purple spots on the skin and

hemorrhages from the gums and nose, and with a small weak pulse. After transfusion of blood she improved but the next day relapsed with rapid, labored respiration and weak and rapid pulse. Her temperature rose to 104.6°F. and her pulse to 165. The blood count just before death was 640,000 red cells, 600 white cells and hemoglobin, 8 per cent. Lymphocytes and large mononuclears made up 54 per cent. of the white cells. These cases of Selling's resembled very closely those described by Santesson (6) of Sweden in 1897.

Apparently this cannery near Baltimore has continued to use the same kind of sealing mixture for from time to time a case of benzene poisoning in a cannery worker comes to the Johns Hopkins Hospital. McClure (7) in 1916 published the history of a woman who was employed in this plant and who began to have obstinate nosebleed, then black and blue spots appeared over the body, followed by shortness of breath, bleeding from the gums and loss of appetite. This patient was given repeated transfusions of blood and eventually recovered, but at one point during her stay in the hospital the erythrocytes had fallen to 840,000 and the hemoglobin to 29 per cent. There is one mention of a white cell count of 1100. I have also notes of two cases treated in the hospital in the spring of 1918, one of them following a progressive downward course with bloody stools, bloody urine and hemorrhage into the ear. At autopsy, the marrow was examined and a note is made of erythroblastic hyperplasia and myeloblastic aplasia.

Dr. T. F. Harrington (8), Medical Deputy Commissioner of Labor of Massachusetts, has had some very striking cases of this same form of benzene poisoning in rubber workers. He describes five such cases in 1917, three of them being fatal. The men were all using rubber cement with benzene as a solvent for automobile tire building, applying the benzene to the rubber by means of a cloth. I will quote only the first of these five cases. This was a man who had worked for eleven months and had early begun to suffer from headaches. Then he noticed that his gums were spongy and bled readily; then spots, like bruises, appeared on his legs and arms and over his body. He became so weak and so breathless that he had to give up work. Two very severe nosebleeds sent him to the hospital. His pulse was 124 and weak; the hemoglobin was 60 per cent.; reds, 2,800,000; whites, 500. Transfusion of 10 ounces of blood was followed by uncontrollable nose-bleed and this recurred daily. He suffered from headaches, dizziness and restlessness, then became delirious, lost power in his arms and legs, sank into a coma in which he died after several convulsions. Before his death the hemoglobin had fallen to 35 per cent., the reds to 1,616,000, and the whites were 850, only 14 per cent. of which were polymorphonuclears.

BENZENE DERIVATIVES

The nitro and amido derivatives of benzene are used chiefly in the production of dyes, perfumes, drugs and explosives. Nitrobenzene is used in industry as the mono and the dinitro compound. The mono compound is liquid and is reduced by the action of iron filings and hydrochloric acid to aniline. It is also used as oil of mirbane in the making of cheap perfume. Dinitrobenzene is a solid. Before the war it was very largely used as an explosive in England and in Germany but not in the United States, so that we have not had experience in industrial poisoning from this compound. Accounts of it, however, fill the German and English literature. We use it chiefly as a dye intermediate.

The action of these benzene derivatives resembles that of benzene in that they act on the respiratory, vascular and heat regulating centers as benzene does, but they do not produce the same effect on the blood cells nor are capillary hemorrhages a symptom of nitro and amido poisoning. These compounds do not give rise to the extreme leucopenia which is a characteristic phenomenon of benzene poisoning. Methemoglobin is formed, and by some authorities all the clinical manifestations are to be explained by the air hunger caused by methemoglobinemia, but there is undoubtedly a direct action on the central nervous system as well. An early examination of the blood shows a polycythemia, though even then the hemoglobin may be low. Later there is great destruction of the reds and a profound anemia, with evidence of effort at regen-

eration of the reds, as seen by nucleated and megaloblastic forms. The blood is chocolate colored, and sometimes, not always, it is possible to detect the spectroscopic lines of methemoglobin. Hudson of the du Pont Company finds in men exposed to the nitro derivatives of benzene, a transient polymorphonuclear leucocytosis followed by lymphocytosis, which he looks on as evidence that absorption of the poison has reached the point where the man must be watched. He does not find this in aniline workers. Curschmann (9) of Germany emphasizes the importance of a rise in blood pressure and a hemoglobin loss of 15 per cent. or more, and Malden (10) of England looks for a stippling of the red cells as valuable a sign in aniline poisoning as it is in lead poisoning.

The dark or smoky color of the urine is noticed by the men themselves very early in their contact with aniline or nitrobenzene. Methemoglobin has been demonstrated, hematoporphyrin, hydrobilirubin, urobilin and bile pigments (11). Hemoglobin and also free blood have been found; albuminuria is not rare. A case of severe albuminuria following acute aniline poisoning was reported to me by Dr. Lippincott of Metuchen. In connection with the urine of workers with these aromatic compounds, one must remember the strange prevalence of bladder carcinoma among them as reported by the Germans among dye workers. Whatever the substance responsible, it seems to be an amido, not a nitro compound. Aniline workers, not nitrobenzene workers, have carcinoma of the bladder.

NITROBENZENE

The cases of industrial poisoning reported in this country are chiefly from the liquid mononitrobenzene in plants making aniline, and it is regarded by experienced men as distinctly more dangerous than aniline. There is not nearly so much poisoning from nitrobenzene as from aniline because the work does not involve so much exposure to nitrobenzene, but when it does occur, it is much more likely to have a fatal outcome, or if less serious, the disability lasts longer than in aniline poisoning.

An account of a serious case of nitrobenzene intoxication may be found in the records of the Massachusetts General Hospital for July, 1916. The patient, an elderly man, was at work in a soap factory, carrying a 5 gallon can of oil of mirbane. He seems to have spilt some of the fluid on his trousers, was noticed to grow rather shaky and then suddenly collapsed, spilling more of the fluid on himself. It is evident from the record that his mirbane-soaked clothing was not removed but that he was sent to the hospital as he was, so that it is no wonder that by the time he reached there his condition was serious. He was unconscious, breathing slowly and irregularly, but the heart was regular with good action. His pupils were small, irregular and did not react. The skin was of a dark gray-blue, anemic color. Some blood was withdrawn from the arm vein and it was chocolate colored. Respiration failed, becoming more irregular and shallow, but the heart action was good till just before death, which occurred one hour after he reached the hospital.

Absorption of nitrobenzene takes place usually. as in this instance, through the skin and of late this fact has become so well-known that in a well-managed plant, an accident, such as the above, would lead to the man's being promptly stripped of all his clothes, sponged off with weak acetic acid or vinegar and then given a full shower bath and made to put on clean clothes. The cases of poisoning from the solid dinitrobenzene are less rapid and severe. At least, I have so far not heard of a fatality. It is among the men especially who have to break up and shovel the solid dinitrobenzene in the crystallizing pans that the most trouble is experienced. Twenty-seven cases of poisoning were reported from one plant last summer and these did not include the milder cases. In another plant, the procedure was productive of so much poisoning among the men that they changed the method and, instead of crystallizing, let the molten compound run into water and granulate. In other places they heat the pan, melt the dinitrobenzene and let it run out.

A very curious history of slow, chronic intoxication with nitrobenzene was related by S. S. Adams (12) in 1912. The patient, a woman of middle age, used nitrobenzene as an ingredient for a cleansing fluid and for eighteen years she was more or less under Dr. Adams' observation. The

symptoms, which progressed very slowly, were those of a multiple neuritis, which finally resulted in contractures and almost complete powerlessness. She had extreme indigestion, even for the simplest foods, followed by emaciation, anemia, weakness and exhaustion. In the twelfth year of her illness she had several hemorrhages from the larynx and the pharynx, without evidence of tuberculous ulcers. The strangest part of the history is the recovery which came after a severe attack of erysipelas, with many abscesses. After these were healed the symptoms of nitrobenzene intoxication cleared up and except for a slight recurrence when she was again exposed for a while to nitrobenzene fumes, she remained well for the five years that had elapsed when Adams wrote his paper.

ANILINE

The symptoms of nitrobenzene poisoning are in all essentials like those of aniline poisoning and the two may be taken up together. A group of American cases of aniline poisoning were reported by Apfelbach (13) of Chicago, in 1913. These men were referred by factory inspectors to Apfelbach on account of the deep blue color of their lips and tongues. The symptoms of which they complained were slight, only headache, slight dizziness, and difficulty in swallowing. The first patient was a press feeder in a printing establishment who had been using a new sort of roller wash to remove the ink from the press rollers. This fluid was found on analysis in the state laboratory to contain aniline. There were no pronounced symptoms; the hemoglobin was over 100 per cent.; the red cells, 5,734,000; and the spectroscope showed methemoglobin lines. The urine was a dark smoky color, but there was no albumin. In the second man, also, methemoglobin could be demonstrated in the blood, but otherwise the examination was quite negative, the only alarming symptom being the blue color of the man's skin and mucous membrane.

The next cases reported were by Birge (14) in 1914. The men in these cases were using aniline black paint, applying it with a brush and then washing the surface with hot water and soap suds—work which naturally made skin absorption easy. The patients were seized with nausea, general weakness, palpitation of the heart, then violent headaches with vomiting. The urine in each case was dark colored, the skin very pale, the lips blue. In 1915, Hayhurst (15) in the course of his survey of the state of Ohio found cases of aniline poisoning in the rubber works and in users of a certain roller wash in printing shops. Aniline had recently been introduced into this industry as an accelerator of vulcanization and in the early days of its use, in 1914, the cases were sometimes very severe.

Dr. R. V. Luce of Akron, Ohio, helped me in a study of aniline poisoning in that city. We found records of coma lasting sixteen, twenty-two, twenty-four and twenty-six hours, though we heard of only one case that proved fatal. In the report of our findings (16), we quoted von Jaksch to the effect that pure aniline is not poisonous and that what is used in industry as aniline is a mixture of meta-, para-, and ortho-toluidine and xylidines. Just lately I have seen this statement repeated, but it is quite erroneous. Chemically pure aniline produces all the symptoms and blood changes that we know to be characteristic of industrial anilism, and I cannot think what von Jaksch meant by his statement. Certainly the experiments of K. B. Lehmann (17) show that pure aniline is very toxic in even smaller quantities than carbon disulphide.

When aniline was first used in American industry we all supposed that the fumes were the danger, not absorption through the skin. A victim who had turned blue in the face and had begun to stagger was taken at once to the fresh air, but we did not realize then that what he needed was to bathe and get rid of the aniline on his skin. It was probably because of this error that the early days of dye manufacture were marked by some severe cases of poisoning in men who had their hands in aniline or its derivatives, or who were working in an atmosphere of dust from screening or barrel packing, or who had splashed a liquid over their clothes.

A case recorded in a Brooklyn hospital was one of the earliest in our literature, and so unfamiliar was the condition to physicians at that time, hardly more than two years ago, that the doctor sum-

moned to the plant where the man lay on the floor in a faint, thought he must surely have fallen into a vat of dye, he was such a deep purple color. This man had been scooping up aniline and had probably spilled it over himself. At the end of about seven hours' work he began to feel twitching in the toes and feet, spreading up the legs, then nausea and faintness. He was made to sit down in the open air for a while but did not wash his hands or change his clothes. He grew weaker, lost consciousness, because deeply cyanosed and his heart was rapid and weak. Almost three weeks later, when interviewed by the physician of the Factory Inspection Service, he was somewhat dazed and unable to collect his thoughts and was too weak to go back to work.

The foreman of a plant in New Jersey who was experimenting with aniline and had his hands in it a good deal of the time, is one of the few cases of fatal poisoning of which we have records. I visited the plant soon after this occurrence and found the ventilation in this department ample, so that fumes could not have played a part in this case. The fellow-workers of this man reported that he never washed his hands upon leaving the plant. He came to work one morning complaining of headache and was advised to go home, but he stayed until noon when he left and, by the time he reached home, was so ill that a doctor was summoned. By one o'clock, he was deeply cyanosed, vomiting yellow frothy material, and his pulse was weak. His doctor did not realize that his condition was serious, but twenty minutes after the doctor had left the patient had a convulsion and, at three, the doctor returned to find the patient unconscious with a very weak heart. He had a second convulsion and the heart action grew steadily weaker till the early morning, when he died. This delayed action of the poison is characteristic of all the members of this group. A man is much more likely to be overcome some hours after he has left the plant than while he is at work.

The rubber industry used to be the greatest source of aniline poisoning, but the growth of the dye industry has displaced it. Moreover aniline is not now used as much in rubber compounding as it was. Instead, aniline-formaldehyde is being substituted, and this is a solid and apparently does not give rise to industrial poisoning. Another substitute is hexamethylenetetramine (urotropin), formed by the action of ammonia and formaldehyde. This, I am informed, has caused some trouble among the men who compound the rubber, but I have been given no details and can only say that it seems hardly likely that any serious trouble could be caused by handling hexamethylenetetramine.

DYE MANUFACTURE

The making of dyes has necessitated the production and use, not only of benzene, nitrobenzene and aniline, but also of an enormous number of derivatives, many of which have a toxic action on the skin, on the central nervous system, or on the blood, or on all three. The chemistry of the dye industry is of a bewildering complexity, and I must not attempt here to go into it in detail, if indeed I were sure of my ability to do so. The compounds used belong to the coal-tar series chiefly. The starting points for the dyes are benzene, toluene, xylene, phenol, naphthalene, anthracene, phenanthrene, and carbazol, all of them being formed on the benzene ring. The first four are decidedly toxic. Naphthalene is very slightly so, the others are apparently inert. Other compounds belong to the fatty series: alcohols, especially methyl and ethyl; the chlorides of ethyl and methyl; formaldehyde; dimethyl sulphate. The heavy acids (hydrochloric, nitric and sulphuric), the alkalis (of which caustic soda is the most important), and certain oxidizing agents (such as lead oxide and potassium bichromate) and reducing agents (such as hydrogen sulphide) are the most important inorganic compounds used.

The toxicity of the benzene derivatives depends partly on their physical properties, whether solid or liquid, volatile or non-volatile. Their toxicity can be partly gauged by their chemical constitution, but only partly. The entrance of chlorine into a fatty compound increases the poisonousness (for example, chloroform is more poisonous than methane), but the benzene series are little, if at all, affected by the entrance of chlorine. Nitration of a product increases decidedly its toxicity; nitrobenzene and nitrochlorbenzene are much more toxic than benzene and chlor-

benzene. Sulphonation (the introduction of the HSO_3 group) renders a compound non-toxic; as soon as aniline is sulphonated it ceases to give any trouble. The introduction of the COOH groups lessens toxicity. Take, for example, salicylic acid as compared with phenol. The introduction of an alkyl group, methyl or ethyl, lessens toxicity; dimethylaniline is less toxic than aniline. The HO group makes the members of the benzene series more poisonous (pyrogallol with three HO groups is more poisonous than phenol with one), while the alcohols are changed to harmless glycols and glycerol.

I shall not attempt to describe the making of the dyes in detail, but only to speak briefly of the different classes of dyes and the dangers connected with each. The azo dyes are probably the safest to make, for though they start with aniline or with one of the toluidines, or toluylendiamine, they do not require the use of large quantities of these bodies, the reactions take place at the freezing point, and the risk of fumes is nil. Sometimes benzidine is the starting point, and this, though closely allied to aniline, is a solid and so far as I know does not cause poisoning. The alizarin dyes start with anthracene, and in oxidizing this substance to anthraquinone potassium bichromate is used, and chronic ulcers are not infrequent among the men in this department. Otherwise, the manufacture of these dyes is fairly safe. The making of indigo requires the action of monochloracetic acid, a powerful caustic, on aniline. In the only indigo factory I have visited, the aniline is made by nitration and then reduction of the monochlorbenzene which the factory produces in large quantities in the course of other manufacture. Consequently, there are here many opportunities for industrial poisoning.

The arylmethane dyes are a very large class, including the malachite green series and the rosaniline-fuchsin series. For these, large quantities of aniline and of para-toluidine are used and also ethyl and methyl anilines and aniline hydrochloride and benzyl chloride. The same is true of the pyrone dyes, to which the eosins belong and the fluoresceins, and the azine and oxyazine dyes of which nigrosin is the best known example. The industrial intoxications that occur in this class of work are from aniline and the toluidines or from their alkyl derivatives, or from aniline hydrochloride or dimethyl sulphate. There are also instances of chlorine poisoning, especially in the manufacture of nigrosin.

The nitro and nitroso dyes are in themselves poisonous and their manufacture involves the danger of burns from nitric acid and poisoning from nitrous oxide fumes. The best known of these dyes are picric acid, or trinitrophenol, and Martius yellow, or dinitronaphthol, and aurantia, or hexanitrodiphenylamine. Finally, the making of sulphur dyes, sulphur yellows, browns, khaki, black and blue, is the most dangerous branch of the dye industry. The intermediates used are benzene, aniline or phenol, and a large number of derivatives, both nitro and chlor compounds, all of which produce a more or less severe dermatitis and the characteristic effects on the central nervous system and the blood of the aniline and nitrobenzene derivatives. In addition, the making of sulphur dyes involves the danger of hydrogen sulphide poisoning.

It is impossible to give more than this brief outline of the way in which dyes are made, for if I attempted more I should get into hopeless complications. I will give a few instances of the reactions involved. Malachite green is made by what is known as a condensation process, which consists in the union of two compounds into a new one by the loss of water or hydrochloric acid. Benzaldehyde and dimethylaniline are mixed for this purpose with a condensing agent, such as zinc chloride, and heated. One molecule of water is split off, the oxygen of the benzaldehyde uniting with two hydrogen atoms from the two molecules of dimethylaniline, and a compound is formed which is tetramethyl-diamino-triphenylmethane. These are really comparatively simple processes in dye manufacture. Sulphur blue is more complicated. For this, benzene is chlorinated, then nitrated, the para-nitro-chlorbenzene is fused with caustic soda to form para-nitrophenol. This is reduced by means of iron filings and hydrochloric acid to paramidophenol, which is then acted on by dinitrochlorbenzene to form dinitro-dioxy-phenylamine, which with sodium sulphide, yields sulphur blue. So far as I know every one of

those compounds is toxic.

Certain factories in the United States make only the dye intermediates. For instance, benzidine sulphate is made by the action of zinc, hydrochloric acid and sulphuric acid on nitro-benzene. The famous Congo red for which there is a large demand in the Orient, is formed when benzidine sulphate is used together with naphthionic acid. This last is made by the action of sulphuric acid on alpha-naphthylamine, in the course of which manufacture very serious poisoning has resulted.

There are also several factories manufacturing para-nitraniline, which is one of the intermediates for sulphur dyes and is also used with beta-naphthol, forming on the fabric the bright red known as German para red. Another important intermediate is the so-called H acid, the chemical name of which is amido-naphtho-disulphonic acid. At one stage in its manufacture nitroso-beta-naphthol is formed, and contact with this causes a severe dermatitis which in one New Jersey town is known as "nitroso itch." Michler's ketone is, chemically, tetramethyl-diaminobenzophenone. It is an important intermediate for dyes such as crystal violet and auramin, and is made by the action of phosgene on dimethylaniline.

One must also take into consideration the use of the heavy acids and the possibility of poisoning from the acids themselves or their anhydrides. The effect of inhaling nitrogen oxides is much more familiar to us now than a few years ago, because, in the manufacture of explosives, this is the form of poisoning that gives the most trouble and causes the greatest mortality. An industrial case of nitrogen oxide poisoning is, clinically, practically the same as a case of chlorine gassing from the trenches. It is not often that fumes of nitrogen oxides constitute a serious danger in dye manufacture. I was told of rather an unusual case not long ago which, though connected with color manufacture, had nothing to do with aniline dyes. A man was grinding chrome green. In some way an iron nail fell into the grinder and a spark ignited the mixture. The head of the factory fire department entered the room wearing a respirator and remained only a few minutes. He went home without realizing that he was injured in any way, ate his dinner and went to bed, but in a few hours awoke with violent abdominal pain and acute air hunger. This increased as edema of the lungs came on rapidly and he died at 5 o'clock in the morning, less than fifteen hours after the accident. This case is typical of industrial nitrous fume poisoning.

Of the fumes from sulphuric acid, I have always supposed that sulphur dioxide was the most harmful. Managers and foremen insist that it is harmless after a man has grown accustomed to the first irritating effects on eyes, nose and throat. Apparently, it is one of the gases which the Germans contemplated using in gas warfare, and according to Lehmann, the effects begin to be apparent when it is present in 0.003 per cent. concentration in the air. Sulphur trioxide is very avid of water, forming sulphuric acid immediately, and the stinging sensation one has on the face and in the throat when in contact with sulphur trioxide is doubtless caused by the formation of this acid. Chlorine gas is given off, especially in the making of benzyl chloride and nigrosin. I have the history of a case of serious sickness in a man who was manufacturing benzyl chloride by passing chlorine gas into pure toluene. His symptoms were: cyanotic color, nervousness, excessive insomnia, fogginess of vision, pain in the region of the liver, and loss of some 25 pounds in weight. It is, of course, impossible to say from which of these poisons—toluene, chlorine or benzyl chloride—he was suffering, or whether it was not a mixed case. Benzyl chloride has, to a lesser extent, the effect on the eyes produced by benzyl bromide which was, we are told, one of the lacrymatory gases used by the Germans.

Finally, I must mention the dangers from caustic soda, which is a very important compound in certain kinds of dye manufacture. In well-managed plants this is handled with great care, and the men who work with it are required to protect their eyes with goggles. In other places I have seen it used with great carelessness, yet a splash in the eye may result in the loss of the eye. Few industrial accidents are more distressing than the blowing up of an autoclave in which caustic fusion is going on, for the scattering of the caustic causes terrible burns.

The cases I shall cite, in illustration of industrial poisoning in this trade, are all from American sources. Indeed, everything I have said about the industry is what I have learned in American plants. Although one cannot get on without the German literature in the study of aniline dye manufacture, still it is never safe to assume that what is done in a German factory, is done in the same way in an American factory.

There is no need to describe further the symptoms of aniline poisoning, but I should like to give a few instances showing the way in which industrial cases occur. A man took off his shoes to save them, and worked in his stocking feet, and as the floor was damp with aniline and water, he became poisoned. A man sat on the top of a barrel to eat his lunch. A little aniline had collected on the top of the barrel, it soaked through his trousers and he absorbed enough to make him sick for five days. Two men were cleaning from an aniline reducer what is called the sludge, i. e., the iron filings used in reduction of nitrobenzene to aniline. One of them worked with bare hands, the other wore canvas gloves but got them soaked. Both were poisoned, but the one with gloves much more seriously. The owner of the dye factory told me that the most serious case they had had was in a man wearing long rubber gloves, who was filling drums with aniline. He let a little aniline run down on the inside of one glove and as he went on working in what was really an aniline poultice, he became very seriously poisoned. Another case that almost ended fatally, was that of a man who tried to mop up aniline from the floor. He got his clothing saturated and fainted, falling with his head on the aniline-soaked floor, where he lay unconscious for an hour before he was discovered. He did not regain consciousness for fully twenty-four hours and was sick for two weeks.

That aniline fumes alone can cause symptoms of poisoning seems beyond doubt. Chemists and foremen who are not in direct contact with fluid may show all the symptoms of anilism, and it is a common experience of workmen that in hot, heavy weather, especially on the night shift, there is always a decided increase in headaches and dizziness and cyanosis. One case of this type of poisoning occurred in a Brooklyn plant. A man was working on the night shift in the dye works and at 10:30 P. M. he climbed a ladder to inspect a vat of dye in process of making. He lifted the lid, inhaled the fumes, and in a few minutes lost consciousness and did not wake till the next morning. He was under treatment in the hospital for a week. The compound in the vat was dimethyl-aniline.

As for poisoning through swallowing, I have the record of only one case, a chemist who was trying to syphon aniline from one drum to another and drew a mouthful into his mouth. He thought he did not swallow any but he at once rinsed out his mouth with dilute acid. After an hour he began to feel weak and languid and went out and lay down on the grass. There he became pleasurably intoxicated, felt perfectly happy and began to sing, but could not be persuaded to move until the doctor came and insisted on his going into the house. On the way, he lost consciousness for a few minutes and fell to the ground. His heart was alarmingly weak, his lips and mouth were a deep blue. The next day he felt as if he were recovering from a hard spree, and for days after he was so weak and languid that he could do nothing but lie in a hammock. His urine was chocolate colored, and after that whenever he came in contact with aniline he would notice a darker color in his urine.

There are a number of compounds with an action similar to that of aniline, some more intense, some less so. Some of these compounds are unfamiliar to the ordinary physician and he is at a loss when he finds obscure illnesses resulting from work with them. For instance, alpha-naphthylamine, the amido derivative of naphthalene as aniline is of benzene, is capable of causing the same, if not more serious damage than aniline. One of Apfelbach's early cases of industrial cyanosis was caused by fumes of this substance.

Usually the symptom complained of most by men working in para-nitraniline is a very painful and itching skin eruption. This is true also of the men who handle dinitrochlorbenzene, made in large quantities for sulphur dyes, and paraphenylene-diamine which is not an intermediate but is used under the name of

ursol as a dye for furs. It is probably really an advantage to the men that this skin eruption occurs, for while workmen will tolerate quite serious systemic symptoms for a long time they will not endure burning and itching of the skin and it usually makes them quit the job. The result is that the management is faced with a shortage of labor which may make operation impossible, and there is nothing for it but to protect the men against the irritating dust, incidentally protecting them against systemic poisoning as well. I know of one factory in which the para-nitraniline men are furnished a full set of clean underwear, a pair of socks, a clean suit of overalls, a clean canvas cap, and clean canvas gloves every morning on going to work. At the end of the day's work, or immediately after an unusually dusty job, they are obliged to take a full shower bath and change into other clothes. This sounds like an expensive method, but the management has found that it pays.

Meta-nitraniline was manufactured rather largely during the war, partly for use as an intermediate for khaki dyes, partly for the making of a new explosive, tetranitraniline. Very little, if any, seems to be made now. The German authorities consider this isomer less poisonous than the para, but experiments made by Dr. Lewis in the Sprague Memorial Institute show that the meta is more poisonous to animals. There was a great deal of industrial poisoning from meta-nitraniline in the ordnance plant that manufactured it last summer, the most dangerous work apparently being at the screens and at the filter press and cooling tubs where, according to the management, the fumes were a source of trouble. I should be inclined to think that the men had got their hands wet and absorbed the paste through the skin. Dinitrobenzene was manufactured in this same plant, but, strange to say, the poisoning from meta-nitraniline, though slower in developing, caused a longer period of disability than the dinitrobenzene.

Aniline hydrochloride is commonly known as aniline salt. It is made and used in large quantities and is recognized in the industry as a poison. It is the substance that was used by Price-Jones and Boycott of England in their experiments on blood changes in aniline poisoning. They succeeded by the use of this compound in reducing the hemoglobin in rabbits to 50 per cent. Microscopically they found basophilic nucleated red forms and megaloblasts. In 1898, Veasey (18) described a case of failing sight in a dyer who was working with what he called aniline salts. The man was suffering from a low grade optic neuritis, and after removal from the fumes, his sight improved decidedly. I do not know whether in this case aniline hydrochloride was the salt used. I am inclined to believe that it was aniline black, in which case pure aniline fumes would be given off.

Mono and dinitrophenols are important intermediates. There were three cases of acute poisoning and death in an American factory last summer where men were handling dry dinitrophenol in the course of manufacturing picric acid by the French method, which differs from ours in not having phenol as an intermediate stage. These cases resembled the ones described by Etienne Martin and M. Guerbet (19) last summer. The French had a great deal of dinitrophenol poisoning in their munition industry and they describe a typical case as follows. The sweat is yellow and this, not on the hands and face, but on the covered parts of the body, showing that it is really an excretion. There is great lassitude and a feeling of constriction around the chest which interferes with breathing. Cyanosis is slight; the heart is unaffected. As the case progresses, there are nervous tremors, sweating, with intense thirst, and then a sudden rapid rise of temperature to 104° F. or over, followed by symptoms of uremia with convulsions, coma and death. At autopsy there may be edema of the lungs, but the other organs show nothing characteristic.

Another case of fatal poisoning from dinitrophenol was reported by Dr. A. S. Warthin (20) of Ann Arbor in 1918. Dr. Warthin did not see the patient, but the urine and liver were sent to him for examination. He found the former a dark yellowish-red, slightly smoky but with a definite greenish coloration, containing a trace of albumin, and abundance of bile pigment. The tests for phenol derivatives, both dinitro and trinitro, were strongly positive. The liver was grass-

green, icteric, capsule shrunken, lobules small. Under the microscope the picture was that of a very acute degenerative hepatitis, such as is found in acute yellow atrophy and after poisoning by chloroform, trinitrotoluene or tetrachlorethane.

The alkyl derivatives of aniline are not as toxic as aniline itself. Cases of poisoning from dimethylaniline which have reached the hospital have usually resulted from an indefensible, excessive exposure. For instance, a man whose case was described by Dr. Lester Roos of the New York State Department of Labor was set to bailing dimethylaniline from one tank to another and worked at this for five hours, probably getting it over his hands and clothing, as well as inhaling the fumes. He was "knocked out," as he said, but felt better after he got into the open air, and was then allowed to go home. He was wearing his working clothes and after he reached home he became dizzy and lost consciousness. He was taken to the King's County Hospital, deeply cyanosed. It was possible to demonstrate methemoglobin in his blood.

In connection with dimethylaniline, mention must be made of a very dangerous poison which is sometimes used in its preparation. This is dimethyl sulphate. Why this substance should be so toxic is not clear to me, but it is known to be so by German dye manufacturers and I find that chemists in this country consider it to be the most dangerous substance they have to deal with, except phosgene and perhaps sulphuretted hydrogen. No cases of industrial poisoning from it have come to my knowledge, but that they have occurred in some of our plants is very evident from the respectful attitude maintained toward it. It is not necessary to use dimethyl sulphate to introduce the methyl group, but it is a cheap way of doing so. If methyl chloride or alcohol is used, the reaction must be carried on with heat and pressure in an autoclave, while dimethyl sulphate will do the same thing without heat and pressure.

Sulphuretted hydrogen is, as I have already said, used as a reduction agent in the making of sulphur dyes. It is poisonous in very small quantities. Danger to life begins when the quantity has reached 0.7—0.8:1000 parts of air, and a proportion of 1.0—1.5: 1000 is rapidly fatal. According to Cushny (21), poisoning is due in part to a local irritant action and in part to a direct action on the central nervous system. In severe cases the latter results in sudden unconsciousness before the irritant effect on throat and lungs is noticed. In the making of sulphur browns, especially, great precautions are taken to prevent the escape of this gas which is dreaded by all foremen. If there is a leak, the effect on the men is almost instantaneous. In one plant, six men were overcome in one night and all had to be carried out. I have been told of several cases of fatal poisoning during the past year, but have not been able to secure any histories. Superintendents recognize that there is an increasing susceptibility to hydrogen sulphide poisoning, and in one well-managed factory a man who has once suffered from the effects is not allowed to return to that department. In this connection, I should like to mention an unusual case of industrial poisoning from hydrogen sulphide which was reported by Canby Robinson (22) of St. Louis in 1916. The patient was not engaged in dye manufacture, he was working in a chemical factory at a tank where hydrogen sulphide was being passed through a copper sulphate solution. He was overcome and fell unconscious to the floor. By the time he reached the hospital, he was conscious though somewhat dazed. The symptom which interested Dr. Robinson especially was a typical, transient auricular fibrillation, which lasted for several hours.

I must not close the description of the substances used in making aniline dyes without mentioning phosgene. It is so familiar to us all, because of its use in gas warfare, that I need not say more about it than that it is an important substance used in the production of Michler's ketone, an intermediate for several dyes. There have already been deaths from phosgene gas among workmen, at least three, possibly five. Two occurred in 1917, before the nature of the gas was well known. It is interesting to note that the industrial cases give the same history of the disastrous effects of muscular exercise after inhaling the gas that we are familiar with among soldiers. An accident which liberated a fairly large quantity of this gas caused poisoning in sev-

eral workmen but all of them were promptly cared for and recovered. An Italian teamster who was outside of the building where the accident occurred, was not known to have inhaled the fumes and was allowed to go on with his work and then go home. He died shortly after reaching home.

There are some compounds used in dye making about which one can make a guess from their chemical composition, though nothing definite is to be found in the literature or to be learned from interviewing practical men. Such an one is nitrosodimethylaniline, and also ethyl and methyl alpha-naphthylamine. Formaldehyde is used in making dyes, and also in other industrial processes. We know very well the irritating effect of the vapors of formaldehyde on the respiratory mucosa and also that certain persons have an idiosyncrasy to it and cannot come in contact with the solution without getting a dermatitis. It is manufactured in Perth Amboy and physicians there are very familiar with bronchitis and even broncho-pneumonia from formaldehyde fumes. In the same factory formaldehyde is combined with phenol to form bakelite, a substance much like hard rubber and used for the same purposes.

Bakelite itch is a commonplace disease in Perth Amboy but I know of no other trouble caused by it. I have already spoken of the manufacture of ammonia-formaldehyde or "urotropin" for rubber compounding. Redmanol, which is phenol-ammonia-formaldehyde, is manufactured in the same place.

Lastly, I want to speak of an interesting report that came to me last summer about calcium cyanamide, resulting from the fixation of atmospheric nitrogen by lime. This substance was made at Niagara Falls and was used as a source of nitrogen in a large trinitrotoluene plant. It is a black impalpable powder, excessively irritating to the skin, so much so that the men who unpacked it were made to bathe at the end of four hours' work and then were shifted every four days. The dermatitis was severe, the substance eating into the skin as unslaked lime does. Sometimes abscesses resulted or sever cellulitis. The physician who described this to me told me that he had never seen any systemic effects, except when a man drank alcohol and then, even if the amount were very small, he would have profound vasomotor symptoms with flushing, sweating, headache, ringing in the ears, and increased heart action. These symptoms would disappear after twenty-four to forty-eight hours. Only once did he see dyspnea in a man who had not been drinking. Once the symptoms came on after a dose of paregoric which was taken for diarrhea.

Soon after hearing this tale, I found the following account in the *Bulletin de l'Académie de médecine* of Paris for July 9, 1918, by J. P. Langlois. He says that workers on calcium cyanamide are likely to have dermatitis and burns, from the lime and the high temperatures to which the calcium carbide has to be raised to make it combine with the nitrogen. But these men are evidently manufacturing it, not handling the product, as the American workmen were doing. However, Langlois has noted the same peculiar reaction to alcohol that Dr. H. E. Lampton of Barksdale had described to me. He says that it is seriously dangerous for such men to drink alcohol, that even a glass of wine will make the pulse go up to 104 and the blood pressure fall to an extremely low point, with rapid respiration. In a typical case, the patient had syncope after drinking 30 c. c. of red wine. The fainting returned whenever he attempted to raise his head, he was nauseated, his face much flushed, and his eyes injected. The blood pressure was low for an hour, but by the end of the eighteenth hour his condition was normal again. Langlois has confirmed on animals this sensitization of the vasodilator system by calcium cyanamide, which is of such a character that a dose of alcohol is enough to make the blood pressure fall. Here we have two almost identical observations made quite independently, one in France and one in northern Wisconsin.

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BOOK REVIEWS

The Six-Hour Day, and Other Industrial Questions. By Lord Leverhulme. Edited by Stanley Unwin. Cloth. Pp. 341 and index. New York: Henry Holt & Company, 1919.

The question of the proper payment, administration, and conduct of labor is justly receiving a great deal of attention at the present time. In fact, the labor question is conceded by practically everyone to be a major problem of the reconstruction period. Much that we hear concerning this great problem comes from the leaders of the labor unions and the authorities on labor questions; it is seldom that a man of standing and experience in the business world who has gained his experience at first hand comes to the front with a statement of his experiences, observations and conclusions regarding labor. It is for this reason that we are fortunate in having in collected form the addresses and essays of Lord Leverhulme, a successful business man who has had first-hand contact with labor for many years.

Lord Leverhulme began his business career at the age of sixteen when he entered his father's grocery store in Bolton. Since that time (1867) he has been actively engaged in business and is now chairman of the firm of Lever Brothers, Limited, soap manufacturers of Port Sunlight.

The book which consists of 27 lectures and essays is divided into five main parts: "The Six-Hour Day," "Co-partnership," "Housing and Social Welfare," "Education and Business," and lastly a miscellaneous collection of lectures entitled "Some Industrial Questions."

It is the author's opinion that the greater portion of humanity is overworked, that the extent of its education is too limited (because of the necessity of entering industrial life at too early an age), and that it suffers greatly by living under crowded conditions. The greater part of the book is concerned with the means for making the most of our supply of humanity, namely, remedying the above faults or ill conditions.

The reports of Vernon (Health of Munition Workers) are cited as proving that the length of the present work day is such as to produce an undue amount of fatigue, an amount which may result in an actual diminution in the rate of hourly production. The author advocates the adoption of the six-hour work day on the basis of these fatigue studies, and suggests the operation of industrial plants in two or three shifts so as to meet the demand for increased quantities of goods. It is not to be disputed that in many occupations fatigue is excessive, but at present we cannot deny the fact that our knowledge of industrial fatigue is very limited; in fact, the reports cited by the author are held by many not to show clearly that after six hours of labor, fatigue becomes excessive or that the hourly rate of production begins to decrease. The author tries to show by means of an example that the unit cost of production would change very little with a change from a forty-eight-hour week to a seventy-two-hour week (two thirty-six-hour shifts) even though the worker were paid the same for six hours work as formerly for eight. It is to be pointed out in the example cited that with this change the direct labor cost of each unit of production would be £1.33 under the new condition as compared with £1.0 under the forty-eight-hour week, and that a portion of the overhead charge caused by power consumption by machinery would increase in direct proportion to the increase in hours of labor and not remain stationary as the author suggests. It would also be necessary to add a charge for the use of artificial light and some additional charge for managerial services (foremen and night superintendents). It would seem that assuming the conditions of the problem as cited by the author, the cost of a unit of production would certainly increase—by just how much it is impossible to state. It is however true that operating a plant for two or three shifts would tend greatly to cut down the cost of production due to overhead charge, but here the author has overlooked a rather important point, namely, the valid objections to night work.

In order to decrease waste and increase quality and quantity of production, the author suggests the adoption of the co-partnership plan. According to this plan the worker is to receive a share of the profits of the concern; but because he does not share any losses he is not to be allowed to exercise any jurisdiction in the management of the enterprise. On the other hand, the fact that he is a co-partner shall not be reason for paying him any less than union scale wage. The author's co-partnership plan has worked out successfully in the plant of Lever Brothers, and the system in use today is the result of over 20 years of experimentation in the methods of rewarding labor for its zeal in promoting the interests and profits of the industry.

Lord Leverhulme's utterances on the subject of co-partnership are highly illuminating and are to be regarded as authoritative on this subject; his plan is, to say the least, an excellent and practical one; perhaps no one man is more capable or has had more experience along these lines than he.

The educational scheme suggested by the author is simply the use of the two hours released by the shortening of the workday for educational purposes. The education of the worker would start at fourteen years and end at thirty. In this period of sixteen years the daily education would be compulsory.

The living conditions of the laboring class have made a profound impression upon Lord Leverhulme. He feels that by proper apportionment of land we can alter the living conditions and so produce a healthier race stock. Many statistics are cited which show the beneficial effect of proper housing and living conditions. Lord Leverhulme's plan here is to distribute land at the outlying portions of the city free to the laboring classes. He reasons further with the object of showing that this scheme would work

out to be self-supporting. In this portion of the work it must be pointed out, however, that there is again a fallacy in the author's reasoning, where he tries to show (p. 160) that the effect of overcrowding *per se* produces a high death rate. Obviously, he has failed to take into consideration several variables existing between the two conditions cited. An important one, for instance, would be occupation. But it cannot be gainsaid that proper living and housing conditions are conducive to mental and physical health and comfort, and that a well-ordered, carefully worked out plan for housing is of great assistance in helping humanity to press forward and develop to its utmost. Lord Leverhulme possesses a remarkably thorough knowledge of all the fine points of the housing problem.

In the last section of the work entitled "Some Industrial Questions" the author discusses in a general way some of our industrial problems, as day work or piece work, the relations existing between labor, capital, and the employer, and again, the six-hour-day and co-partnership.

Lord Leverhulme has written a most interesting and enlightening book, not from the point of view of the reformer or the labor leader, but from that of the business man. His driving object is to make the world a more liveable place for all; an end which he feels can be attained without the sacrifice by laborer, capitalist, or employer of any of their rights or privileges, but rather by the co-operation of these three to the fullest extent. His thorough understanding of the fundamentals of this great problem and his practical co-operative and not philanthropic views cannot but make this volume appreciated by those who are seeking light on this most important question.—*Leonard Greenburg.*

Organization in Accident Prevention. Sidney Whitmore Ashe, B.S., E.E., Head, Educational and Welfare Department, Pittsfield Plant of the General Electric Company. New York: McGraw-Hill Company, 1917.

This small volume of 120 pages gives a simple, non-technical summary of the methods used by one large concern in attempting to control its accident frequency. It seems to be quite unevenly balanced, giving undue emphasis to the less important methods, at the expense of some of much greater value. More than five times as much space is given to the Prone Method of Resuscitation than is allotted to Education in Accident Prevention.

The writer presents few of the reasonable arguments for physical examination of employees. The charts used throughout the volume are in particular open to criticism.

However, much of the book is very commendable. It is entertaining and should be stimulating to employers who are new in the field of accident prevention.—*Chas. F. Horan.*

BOOKS RECEIVED

Books received are acknowledged in this column, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Municipal Housecleaning. The Methods and Experiences of American Cities in Collecting and Disposing of Their Municipal Wastes—Ashes, Rubbish, Garbage, Manure, Sewage, and Street Refuse. By William Parr Capes, Director, New York State Bureau of Municipal Information, Secretary New York State Conference of Mayors and Other City Officials, and Jeanne Daniels Carpenter, A.M., LL.B., Expert in Economics and Municipal Research, Boston University. With an Introduction by Cornelius F. Burns, President of New York State Conference of Mayors and Other City Officials. Cloth. Pp. 232. New York: E. P. Dutton & Company, 1918.

Geriatrics. A Treatise on Senile Conditions, Diseases of Advanced Life, and Care of the Aged. By Malford W. Thewlis, M.D., Associate Editor, Medical Review of Reviews, New York City. With Introductions by A. Jacobi, M.D., LL.D., and I. L. Nascher, M.D. Pp. 250, with illustrations. St. Louis: C. V. Mosby Company, 1919.

Symptoms of Visceral Disease. A Study of the Vegetative Nervous System in its Relationship to Clinical Medicine. By Francis Marion Pottenger, A.M., M.D., LL.D., F.A.C.P., Medical Director, Pottenger Sanatorium for Diseases of the Lungs and Throat, Monrovia, California; Professor of Diseases of the Chest, College of Physicians and Surgeons, Medical Department, University of Southern California, Los Angeles, California. Cloth. Pp. 328, with illustrations. St. Louis: C. V. Mosby Company, 1919.